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EDITORIAL.

WHAT OF THE FUTURE?

SINCE Anæsthesia is a part of the keystone of the Surgical Arch it is of vital importance to raise it to the highest state of perfection. Surgery, as we know it to-day, began with Morton and Lister. Has surgery reached that point of perfection when it may be said that anæsthesia can be of no greater use to it? The reply is obvious. Just as the anæsthetist's aid has in the past enabled the surgeon to improve his technique so in the future the anæsthetist must continúe to perfect his methods to keep pace with surgical progress.

We have by no means reached saturation point in the art of safely removing that pain and shock which are the necessary concomitants of all surgical procedure, nor have we yet developed the ideal anæsthetic. Statistics make it pathetically clear that deaths are still all too frequent, and there is still a long way to travel to the goal of perfection.

Can it be truthfully stated that all is being done in this endeavour that may be done? Anæsthetists realise that the answer to this question is in the negative. Despite the fact that lives are being lost which might otherwise be saved if our art were a more perfected one it is a fact that our efforts to reduce this unnecessary mortality receive only hesitating encouragement.

The position is an anomolous one. Here is a matter which concerns the safety of all humanity and yet the voice which would make itself heard in its service passes practically unheeded. Every day and every night in every country the operating theatre functions. Sufferers are entering that

insensibility which will permit the surgeon's skill to mend or relieve. How important it is to ensure that these will "come out" of this unconscious state safely! And yet how many there are who will not return from the Valley of the Shadows because the Art of Anæsthesia is still imperfect!

Does it not seem paradoxical that despite the fact that this tragedy is repeatedly occurring everywhere no effort is being made to overcome it on that grand scale which alone can prove availing.

Anæsthetists are very much alive to this problem. Both individually and collectively they strive to attain the perfect anæsthetic, but something more than their efforts are required. The truth is that because anæsthesia is of such impelling and vital need to humanity, a portion of humanity's wealth must be allocated to perfect it. Without FINANCIAL HELP it will continue to lag, and must in consequence remain what it is to-day, a faltering hand-maiden.

What can we say of the present status of anæsthetic instruction? This, that it is not worthy of such an important branch of surgery. True, here and there attempts are being made with varying success to provide courses intended primarily to meet the barest needs of the novice and post-graduate. But, in most part, these do not and cannot create the highly efficient student and practitioner. For this, something more than is at present available is required. IN FACT, NOTHING LESS THAN A WELL EQUIPPED DEPARTMENT OR SCHOOL WITH PAID INSTRUCTORS CAPABLE OF TEACHING ALL THE VARIOUS TYPES OF GENERAL AND REGIONAL ANÆSTHESIA AS WELL AS THE PHYSIOLOGY, CHEMISTRY AND MECHANICS OF THE SUBJECT WILL SUFFICE. At the same time, laboratories for continuous research are urgently needed to further investigation. Such a departure would serve the double purpose of furnishing qualified men prepared to take up high grade anæsthetic work, and, at the same time, introduce a new and much needed type of scientific investigator.

This matter of safe and efficient anæsthesia is worthy of the attention of our great philantropists. One has but to point to the benefits of painless child-birth, painless and shockless operations generally, painless post-operative dressings, painless tooth repair, etc., to stimulate the imagination

as to future possibilities. Or to further improvements which would lead to special anæsthesia to meet the requirements of those special cases which react at present only too poorly. Then, too, as the surgeon's skill and daring invade more boldly the little explored sections of the body, an anæsthesia will need perfecting in keeping with this advance—in fine, a *shock-proof* anæsthesia which will permit of the greatest strain to the nervous and circulatory systems.

In envisaging a New Era in Anæsthesia, is it too much to believe that, notwithstanding the great surgical advances made within the past century, that, in point of fact, we may now be actually standing upon the brink of a New and Greater Surgical Age. Who knows but that procedures hitherto undreamt of and at present deemed even unthinkable, may by the aid of a 100 per cent. perfected anæsthesia technique, be brought well within the range of practicability.

The surgeon brings his operation to a close in some cases because he feels that the patient may not survive the shock of further manipulations. Perhaps a more radical attempt would bring about the cure aimed at. If an anæsthesia technique were available which would carry a patient along without shock, for longer periods, the surgeon could venture boldly where now great caution is imperative.

Is not the possibility of this attainment worth the expenditure of money along the lines suggested? Such a consummation is truly worth the interest of those great foundations which have been established to help humanity.

We respectfully submit that the very general belief that anæsthesia has been perfected and that no further advance is necessary, is both fallacious and dangerous. This "good enough" school is unscientific and unprogressive. Anæsthetists of many years standing, and who are still daily on the "firing-line," advise against this *laissez faire* policy, and declare to those in a position to help, that the art of anæsthesia may be brought to the proper degree of perfection only by the ***encouragement inherent in instruction and research.***

THIRD OF THE SERIES OF
PIONEERS OF MODERN ANÆSTHESIA.
SIR FREDERIC WILLIAM HEWITT.

By J. BLOMFIELD.

DURING the early years of this century, Hewitt's name was pre-eminent as an anæsthetist. It was known, almost alone in his branch of practice, to the general public in this country, and indeed throughout the civilized world. This unique position was not due solely or even chiefly to his participation in the operation on King Edward VII in 1902. Even before this date Hewitt had made his name familiar to the public both by the large practice which he had acquired and by his frequent writings. These dealt not only with the actual practice of his art, but also with what may be called the social and educational aspect of his branch of the profession. It is impossible to estimate truly the value of his work if we do not keep constantly in mind the dual nature of the object which Hewitt had always in view and towards the achievement of which he never spared himself either in time or in labour. This dual object was improvement in the administration of anæsthetics and improvement in the standing of those occupied in this branch and in the regard with which they were held by their professional colleagues and by the public at large. To so great an extent has this object been achieved that it is difficult for the generation of to-day to realize that there was ever any need for the constant efforts which Hewitt made to draw attention to the subject of anæsthetics and the positon of anæsthetists.

He was convinced that the study and practice of anæsthetics were worthy of much greater attention than was being bestowed on them. Accordingly, Hewitt was engaged in a self-imposed crusade wherein he preached both to his own profession and to the public the necessity of developing that regard and respect for the art of giving anæsthetics which its importance demands in relation to the saving of lives.

He always maintained that the majority of anæsthetic fatalities were preventable, and that the way to prevent them was by improving the personnel of those engaged in the administration of anæsthetics.

How perfectly justifiable was his dissatisfaction with the position of anæsthetics at the time may be decided when we compare it with the present state of affairs, capable though these are of considerable improvement.

To-day there is no large hospital without one or more specialists to take charge of the anæsthetic side of the work of the institution. Students are obliged to undergo training in anæsthetics, for the examinng bodies require evidence that they have done so before candidates can compete in the qualifying examinations.. The position was very different twenty years ago when Hewitt was at the height of his activities. In 1907, out of twenty-seven examining bodies which granted diplomas in medicine and surgery, only eight insisted on any evidence of instruction in anæsthetics. The success of Hewitt's campaign may be gauged by the fact that only four years later, in 1911, the General Medical Council was able to state that every Body in Great Britain included evidence of instruction in anæsthetics among their requirements from candidates for the qualifying examinations. This improvement in the academic position of the study of anæsthetics went hand in hand with an increasing recognition of the importance of the anæsthetic in successful surgery, an increasing regard for those engaged in anæsthetics and a corresponding increase in the number and improvement in the standard of practitioners devoting themselves to this branch of medicine. For all these things, although of course not solely, Hewitt was very largely responsible.

Hewitt believed that legislation was required restricting the administration of anæsthetics to duly registered medical practitioners and separating the responsibilities of the anæsthetist from those of the operator. As the law stood (and now stands) anæsthetics may be given by wholly unqualified persons. "Surely", wrote Hewitt, "the law should protect individuals who innocently submit themselves to the influence of the most powerful drugs in the British Pharmacopœia at

the hands of those who are utterly ignorant of the risks involved; and surely the responsibility in administering an anæsthetic should rest with the administrator and not, as has been held, with the operator."

His efforts to arouse professional and public opinion on this question were unceasing. So successful were they that he had brought matters to the point at which a Bill had been drafted by a Departmental Committee of the Home office and was duly before Parliament. It was only the delay caused by critical public affairs and then the advent of the Great War which prevented this Anæsthetics Bill from being passed. By his untiring energy and his reasonable, though enthusiastic, persuasion, Hewitt had won over to his cause men and bodies of men who were at first not merely indifferent, but often actually inimical. It is only necessary, in order to show the effect of his endeavours, to state that he eventually received effective support from the General Medical Council, the Council of the Royal College of Surgeons and the British Medical Association, as well as several less influential organizations.

We are, however, anticipating and must go back fifty years or so to give this little memoir a proper sequence.

Frederic William Hewitt was born in 1857. He was educated at the Merchant Tailors School in London, and at Christ's College, Cambridge, to which institution he passed with a scholarship in natural science. At the University, Hewitt played a normal part in the social and athletic side of college life, being no mean performer on the running track and on the football field, and indulging to the full that capacity for friendship which was always a prominent feature of his later life in London. He entered St. George's Hospital Medical School and soon made his mark as a successful as well as a popular student. He obtained the Brackenbury Prize in medicine and the Treasurer's prize, and served as House Physician. Then, setting up in modest rooms with his great friend, Mr. Marmaduke Shield, he took pupils in medicine, while Shield did the same in surgery, both hoping thus to tide over the difficult period before enough practice in their respective lines came along to support the *menage*.

With a rapidly rising reputation in medicine among his contemporaries and much sought after as a coach by his immediate juniors, Hewitt seemed obviously in the running for a physician's appointment at his hospital. We may be surprised to find him turning aside to the then comparatively insignificant career of an anæsthetist and may wonder at his deflection if it were not supplied in the explanation of his action. The chief reason was the necessity for earning enough money, but a second lay in that physical weakness —extremely defective eyesight—which hampered him throughout his professional career and which might well have brought failure to any man of less courage and perserverance. The gravity of his defect was brought home to him when he failed to observe, because he could not see it, a skin affection in a certain patient whom he was examining in a competitive examination at St. George's. Hewitt was found to be suffering from an obscure and irremediable retinal affliction. The foremost authority on ophthalmology of that day could only recommend six months in complete darkness, without any guarantee of improvement. Hewitt with characteristic pluck and decision determined to ignore his eyes and take up a branch of practice wherein defective eyesight was no necessary bar to success. Anæsthetics were already being, in a measure, forced upon him, surgical friends finding him a safe and careful administrator. He deserted medicine for anæsthetics and if the former probably lost a successful physician, the latter certainly obtained a worker whose efforts left permanent and far reaching improvements to the art of his adoption.

Obtaining the posts of anæsthetist to the Royal Dental Hospital and the Charing Cross Hospital and later to the London Hospital, Hewitt found copious material from which to learn himself and through which to provide instruction to others. In 1888 he published a small book on "Select methods in the administration of nitrous oxide and ether, a handbook for practitioner and student" and showed that his writing was stamped with that same clearness of exposition and conscientious care in detail which had made his oral teaching so successful in earlier years. There can surely have seldom been a more careful writer than Hewitt, and the permanent value of his well known text-book depends mainly on this, that

there is not in it a sentence which was lightly written or passed without deliberate scrutiny and not a reference that was not carefully verified. When we remember that all the work for this book and his other writings had to be done through the medium of a secretary and an amanuensis, because of the author's own defective eyesight, we may well rank Hewitt's achievement not far below those of the great Englishmen who have refused to allow even actual blindness to diminish their activities. In 1892 Hewitt brought out as a small book, a paper which he had read before the Odontological Society entitled "Anæsthetic effects of nitrous oxide and oxygen when administered at ordinary atmospheric pressure, with the records of 800 cases."

This work did much to popularize "gas and oxygen" for dental operations. It was based on many most carefully observed clinical cases and on a large amount of experimental work which Hewitt had carried out in conjunction with Sir George Johnson. This bore largely on the action of indifferent gases, nitrogen for example, and is among the most convincing proofs of the physiological doctrine that anæsthesia is not synonymous with asphyxia, although suboxygenation is almost a constant accompaniment of narcosis.

In order to obtain apparatus capable of administering "gas and oxygen", Hewitt employed that natural inventiveness which prompted him to the introduction of so many small devices useful in the technique of anæsthesia. Props, gags, and air-ways, all still in common employment by the anæsthetist of to-day are examples. For his "gas and oxygen" apparatus he constructed at home with the assiduous and capable help of his wife a complete model in card-board from which the makers were enabled to produce the actual working machine. The use of "gas and oxygen" in major surgery has, of course, made great strides since Hewitt's day, and the introduction of upright cylinders and re-breathing with the "sight-feed" has well nigh revolutionized the method. It is, however, noteworthy that even with his original apparatus, devoid of re-breathing or any arrangement for the introduction of ether, Hewitt successfully conducted many long administrations.

The writer well remembers the account which Hewitt gave him of one case in particular. "Gas and oxygen" was given for fifty minutes to a lady in her bedroom while manipulations were carried out and plaster applied for the remedying of a fractured thigh. Hewitt's ingenuity was considerably taxed on this occasion in devising an arrangement which permitted his apparatus to be in use by the side of a large bed and allowed changing the empty cylinders for full ones without interruption of the administration.

Besides the numerous improvements in apparatus devised by Hewitt which included, in addition to those already mentioned, his important and now widely used modification of Clover's ether inhaler, Hewitt was largely responsible for improvement in the entire principle of anæsthetic administration. He was among the first, if indeed not actually the first anæsthetist, to insist on the importance of looking at each case as an individual problem for the correct meeting of which all the circumstances of the patient and operation must be duly weighed. There could be no wide success in the administration of anæsthetics, he maintained, if the anæsthetist were merely a routine dispenser of certain agents. For every patient the correct agent must be carefully decided on in accordance with the patient's state of health and the requirements of the surgeon. Hewitt affirmed that the responsibility for choosing the anæsthetic and the full responsibility for administering it must be put on the shoulders of the anæsthetist alone. Naturally, he would in many instances consult with the surgeon before settling on his procedure, but the responsibility for every result directly dependent on the anæsthetic could in no degree be delegated to the surgeon.

Half a century ago, he wrote in a preface to his text-book, "when operations were of short duration and anæsthetics were administered under the direction of the operator, there was, perhaps, some reason for the acceptance by the latter of the entire responsibility of the case. But matters have completely changed and it not infrequently happens in the surgery of to-day that the *rôle* played by the anæsthetist is of even greater importance than that played by the operator. The time has come, indeed, for a clear recognition of these two distinct

responsibilites." This opinion is now, of course, commonly held and has indeed been endorsed by a judicial utterance. When stated by Hewitt, however, it expressed an advanced idea that was by no means agreeable to the notions of many of the surgeons of the time.

Hewitt's text-book appeared in 1897 as a result of ten years experience and careful notetaking. It was a success from the first, and is now in its fifth edition and remains probably the best systematic exposition of the theory and practice of anæsthesia in any language. The publication of the work did much to arrange clearly the knowledge on which the art of anæsthetic administration is founded, to lay down the principles by which it should be guided and to describe in detail the technique to be employed, the difficulties that may arise and the logical measures for preventing and for meeting them.

Hewitt was eminently well equipped for producing a text-book on his own subject. He was astoundingly industrious, most careful and possessed of good judgment. Moreover, his mind was methodical and his inclination was always to study the practical rather than the purely theoretical side of everything concerning anæsthetics. Consequently, his book was not only easy to read, because of the great care expended on its composition, but it teemed with advice and experience which were of the greatest value to the practising anæsthetist. The great worth of the book was at once appreciated in America as it was here and it had, and doubtless still has, a wide circulation among the anæsthetists and practitioners of the United States.

It is an interesting comment on the progress of anæsthetic administration to note that although he described it in his book, Hewitt never practised either the nasal administration of nitrous oxide, or spinal injection. The former he objected to on principle, so keen was he on the constant use of the oral respiration in all inhalational anæsthesia. Moreover, he was averse to extensive multiple extractions in the dental chair. There is no doubt that the great utility of "nasal gas" has demonstrated that Hewitt's position in this question was an untenable one. Nevertheless it is worthy of remark that the extremely rare fatalities under nitrous oxide for dental extraction have occurred for the most part with the nasal method.

The sacral and para-sacral methods were as foreign to Hewitt's practice as the intra-thecal injection and he never embarked on the intra-tracheal method. This proceeding, which has become, of course, a well established method of the highest value in properly selected cases, Hewitt described to the writer after his first witness of it as "anæsthetic looping the loop."

In person, Hewitt was about middle height and of an active frame. Yet he did not look robust owing to his sallow complexion and rather drooping eyes. His activity was maintained rather by a strong will than by an abundant robust physical energy. He did not allow himself to tire or to remain idle. In company, Hewitt was quiet but humorous, and he had a natural kindness of heart which was always evident and which was indeed one of the sources of his great success with patients. In his home life he was happy and during the latter years of success, enjoyed at the country house which he took on the heights near Henley, an amount of recreation which had been denied him for many preceding years.

Looking back on his career it is not hard to see the causes of Hewitt's success. He was possessed of qualities which would have brought him to the front in most walks of life. Industry, perseverance, courage, thrift and singleness of purpose are not to be denied in whatever profession or trade they are found. To him who possesses these qualities, success will come sooner or later and there is no need for that "luck" to which the success is often attributed by those who do not realize what is behind it.

Hewitt graduated M.D. at Cambridge in 1884. He was made an M.V.O. in 1902 as a recognition of his services at the operation on King Edward VI. He was knighted in 1911. After being anæsthetist to the London Hospital for many years he returned to his own school, St. George's, as Physician Anæsthetist in 1902. The post was especially created for him He was appointed anæsthetist to His Majesty in 1901, an office which has only been occupied by one other individual.

THE TEACHING OF ANÆSTHETICS IN MEDICAL SCHOOLS.

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THE experience of more than half a century has indicated to us that no subject in the medical curriculum calls for more accurate and practical teaching than does anæsthesia. How far the medical schools supply facilities for this teaching and to what extent the students avail themselves of such opportunities as are offered them, opportunities for personally administering anæsthetics, it is not easy to determine. Much depends upon the official anæsthetist and the lecturer on anæsthetics attached to each school, and whether they are given a free hand. This, however, is seldom the case. But outside these aspects of the matter there are wider issues which are less capable of being controlled. The curriculum is already crowded and students who are guided by tutors and junior lecturers or demonstrators whose interests lie in the more luscious regions of Medicine, a subject which has now assumed enormous proportions are not attracted by the subject of anæsthesia. The result is little spare time or energy is willingly allotted to anæsthetics. The student, let loose from physiology and anatomy, fastens with avidity upon the domains of the stethoscope and scalpel and so he and his fellows pursue the line of least resistance, and give little heed to the allurements of chloroform and ether with their attendant sprites.

The surgeon and the pathologist are the units which take an interest in anæsthetics. The surgeon demands the nearest possible approach to perfection in anæsthetic methods and, according to the region of the body which is dominated by his speciality, asks for this or that manner of administration and for one or another narcotic or narcotics which he judges will render him most services. It is not a matter of indifference to

him that the steps of a complex operation are hindered by the divarigations of an inept anæsthetist. At times, the patient may be nearing the Styx, at another, he may be in a semi-conscious state and take too active an interest in the manipulations of his good friend the surgeon. Such things make for trouble and the anæsthetist finds himself between the devil and the deep sea—the operator and the student. His popularity suffers on both sides, for the surgeon justly demands what it is often the impossible under existing circumstances, and the student feels he is ill-used because his stock of knowledge falls below that demanded in the science essential in the operating theatre.

To see the expert at work gives the student, in his soul-wrapped ignorance, the impression that the giving of an anæsthetic is what any fool can do or should do without difficulty or danger, until the advent of difficulty, and the horror of the experience of danger sickens him and he shirks the chloroform bottle as the devil does pitch.

Another difficulty as regards the student arises from the fact that he does not appreciate the practical value which a knowledge of the uses of and the methods of using anæsthetics is going to be to him later when he is in practice. The student is necessarily a utilitarian and as a rule works less for the sake of knowledge as such than for the next examinational test to which he will be subjected. Again, the period at which the use of anæsthetics is taught is usually too early in the student's career. No man can grasp the inwardness of anæsthetic technique until he has seen and studied its application to surgery and to operations. After all we have to admit that the *alpha* and *omega* of anæsthetics are the requirements of the surgeon in order that he may complete his work thoroughly and rapidly and within the limit of safety for the patient.

The actual sources from which the students can gain knowledge of anæsthesia are the lectures on (1) pharmacology (2) those on surgery, (3) special lectures, usually few in number, and (4) demonstrations in the uses of anæsthetics in the Out-Patient Department, in the Casuality Theatre, in the Maternity Department, and in General Operating Theatres. He is shepherded perhaps by a junior in the physiology department whose teaching, like that of the professor of phar-

macology, is theoretical and divorced from the details of the subject an accurate knowledge of which is a *sine qua non* in the practice to be pursued in a surgical theatre.

Within the limits of a magazine article it is impossible to compress an ideal course of instruction and still less is it possible to traverse the objections which are sure to be raised by the teachers and by that long suffering body of men, the hospital staff. The medical staff will complain that their House officers and their clinical clerks are called away from their wards at times when their presence is greatly needed in the wards, while the surgeons will somewhat naturally point out that except for occasional routine cases, their operations are hampered and even their best efforts frustrated by attempts at anæsthesia made by novices which are foredoomed to failure. However, these difficulties, I submit, can be overcome if the same acumen is shown by those who arrange the classes dealing with anæsthesia, as is demonstrated by teachers of subjects other than anæsthetics. Possibly a little more sympathy shown towards that unwanted bantling named Anæsthesia would do much for the happiness of all concerned.

The use of anæsthetics is essentially an experimental procedure. We know, within limits, the behaviour of these agents under test conditions. We know the effects of dosage, of association of several agents, as in the case of the use of alkaloidal bodies given before an inhalation; the combination of alcohol or ether with chloroform. We know how temperature, barometric conditions, posture and recognizable pathological states such as uræmia, glycosuria, cholæmia, variations in blood pressure and so on, modify the behaviour of anæsthetics, but what we do not know is the personal equation of the patient. At this we must guess, and our guess will be more or less near the truth according as we possess experimental knowledge and experience as well as a mind trained to investigate the problem placed before us for solution as well as the "will' to study and, if possible, to solve that problem. It is the possession of this "will" to investigate and be guided by the factors emerging from the study of the case which constitutes the difference between the casual and therefore dangerous, and the expert person who undertakes to give an anæsthetic. It is, I submit, the end and aim of all

useful teaching to foster this "will" and provide sufficient knowledge and skill to exclude the casual and promote the expert administration of anæsthetics. In order that the full benefit shall be taken of the anæsthetists' knowledge and acumen it is necessary that he be afforded an opportunity of studying the state of the patient and be put in possession of the nature of the surgical procedure which is to be pursued.

In order, then, to equip the student with the essential outfit as an anæsthetist we must assume he has undergone clinical teaching in the medical wards, so that his work in anæsthetics, at least the manipulative portion, must not be carried out until fairly late in the curriculum. However, the teaching of the neophyte in anæsthesia should commence quite early and be committed to the hands of the physiologist or pharmacologist, still better, each of these instructors should devote a few lectures, say three, entirely to the physiological behaviour of narcotics used as anæsthetics. Demonstrations with the pithed frog and, if possible, with other animals, making use of Waller's balance inhaler, would help to inform and interest the student in a subject which is often thought to be and taught to be arid and boresome. In the pharmacology lectures greater accuracy than is often at present attained should be insisted upon and the methods of preparation and detection of impurities carefully explained. A few special lectures in the anatomy course, dealing with surface marking for nerves would be valuable in view of local analgesia. Then should come demonstrations upon the mechanical technique of anæsthesia, apparatus for local, general and spinal anæsthesia and approved plans in cleaning and sterilizing them.

It is a very great advantage at this stage for the student to attend systematic lectures on the uses of anæsthetics and these should be illustrated copiously with diagrams showing apparatus, positions of patients, methods of lifting anæsthetized patients and so on. Such procedures as opening the mouth, separating the jaws, the way of introducing tongue forceps and how to pass the thread across the tongue to pull it forward should have been gone into when the apparatus technique was explained. It can with advantage, however, be explained again in this course. When the general methods of giving the anæsthetics are mastered, those required for

special types of operation, throat, mouth and tongue, Trendelenburg position, brain, spine and abdominal sections should be dealt with.

No student can learn properly the inwardness of conducting anæsthesia unless he has an opportunity of studying the patient's condition; (1) before, (2) during, and (3) after the administration. I believe, whenever it is possible, that this can best be done by the use of properly ruled case-sheets such as I used for some years at University College Hospital. Columns were provided for the patient's name, age, sex and physical condition; and the pharmacological essentials. It is not always possible or expedient for the student to examine the patient at all fully but he can always gain access to the Registrar's or surgical clerk's notes, examine the urine, pulse, respiration, and form a rough opinion of the state of the patient. Under the second heading on the sheet are to be inserted the nature of anæsthetic, the method of use, the quantity and phenomena of induction, those of maintainance and of recovery with the duration of these. If great loss of blood or shock is produced, the patient should be examined for some days after the operation *i.e.* urine, temperature, nausea, vomiting should be noted and if sequelæ such as catarrh of bronchi, alimentary tract kidneys or post-operative toxæmia develop. It is a great help to the student if the instructor goes over the notes of any case of especial interest. Unless supervision is exercized and the teacher takes pains to interest the student in this branch of the training and tells them that they will find a competent knowledge of anæsthesia of the utmost value when they get into practice, they will weary of the note taking and scamp it.

We now come to the actual administration of the anæsthetic. When possible the first few anæsthetizations should be done for minor cases—not throat cases—in "Outs," Casuality and so on. This can only be done with some responsible officer, such as a Registrar in anæsthetics or a Resident who is specially trained to do this teaching . After say, six cases, the neophyte should be handed over to one of the Honorary Anæsthetists who will demonstrate to him the procedure to be carried out in the major operation theatre.

In this way it should be possible for the student to give

the anæsthetic in such a manner as to avoid any inconvenience to the surgeon. It is obvious that during the first week or so the student should be entrusted only with the simpler cases. The instructor would be, as a matter of course, always at hand to deal with any minor difficulty or untoward complication. The student, if keen, will, in a month's time, have acquired quite an intelligent grasp of his subject and will daily gain experience, self-confidence together with an adequate sense of his responsibility. The point I am anxious to emphasize is this: if the routine of examining the condition of the patient before the administration of the anæsthetic, the incidents of the actual inhalation, the recovery and the post-operative conditions, *i.e.* those concerned with the anæsthetic, are carefully studied, the student anæsthetist obtains a complete picture or series of pictures of the patient during the time he is, more or less, under the influence of the anæsthetic. He learns that there are certain factors producing results which he can see and appreciate. Of these, some make for the advantage, others for the detriment of the patient, and knowing these facts, the student is able to note at what he should aim and what he should avoid when he encounters similar cases on subsequent occasions. These factors are soon determinable, such as the recognized effects of the patient's physical reaction towards the anæsthetic, the reaction due to the operative procedure, but others cannot be estimated. Of these last, we have to consider the mentality of the patient.

It is a remarkable fact that the nervous systems of persons, more or less similar, show extraordinary variations in their reaction to the taking of an anæsthetic. The "highly strung" person, the so-called hysteric and the neurasthenic project their diathetic peculiarities not only into the first stages of the subliminal state, but even into the actual degree of anæsthesia when sensation, and presumably cerebro-spinal conduction are either abrogated or materially lessened. We have nervous storms, inhibitions, interference with circulation and respiration. The student has to learn to distinguish between such states, possibly the unconscious rigidity or muscular contraction due to such intercurrent nerve storms and the irregularities and movements arising from some lack of expertness on the part of the anæsthetist who has failed to superendure a

sufficient depth of narcosis and has allowed the patient to be in a condition of oscillating between excessive and deficient strength of the anæsthetic being inhaled.

A point insisted upon by the late Professor A. D. Waller, and one of greatest importance, is that students should be taught to appreciate the effects produced by various strengths of anæsthetic vapours. To render this possible he designed his chloroform balance and the installation of this in every medical school would be a great asset to the teachers of anæsthesia. One goes back to the words of that great man, John Snow, who was the first to demonstrate that a certain definite strength of chloroform must always bring about certain definite results, so that given a knowledge of this strength we possess a sure knowledge of what state the patient is in and whether he is anæsthetized, drugged or poisoned by the vapour he is receiving.

It will be urged that even if my premisses are admitted, I am asking for a council of perfection. It is impossible, it is said, to burden the curriculum still further with a subject not recognized as one of first class importance, being taught systematically throughout the whole of the hospital course rather than relegated to odd times and casual occasions.

The answer to this is simple and thoughtful members of any hospital school teaching staff recognize and admit its validity.

It is not necessary to increase the number of hours devoted to anæsthetics; what is required is that the teaching shall be systematized and so arranged that some teachers may deal with elementary aspects of the subject while the experts assume command when the actual teaching in the operating theatre is being carried out. Clinical lectures, a few will suffice, should be given upon such subjects as "The Status Lymphaticus," Post-operative Toxæmia" and so on.

A further matter calling for reform is that although the subject of anæsthetics is scheduled for inclusion in the range of the examinations, it is commonly signed up for by the dean of the medical school and students attend lectures or demonstrations at their own sweet will and seldom do so regularly or properly. Nor does one see questions dealing with the subject set in the examination papers; were such a

question occasionally inserted there would certainly be a fluttering in the dovecotes and the subject would be treated more seriously.

It would be a very great help, not only to the instructor in anæsthetics and the senior anæsthetist but also to the surgical staff if every hospital appointed a paid officer, called Registrar in Anæsthetics, whose duty it would be to undertake the preliminary teaching and be prepared to do a certain definite amount of anæsthetizing in the subsidiary surgical theatres and for emergencies. He should, when possible, hold office for a year, be a resident and be debarred from private practice and from acting as a substitute for the honorary anæsthetists. Further, he should be responsible for the records of the anæsthetics given, the notes about serious after effects and, if such occur, of deaths with *post-mortem* examinations.

A special certificate of efficiency with the experience of say fifty personal administrations would be keenly sought for and could be granted after a special examinaton. Post-graduate courses in anæsthetics are greatly needed. Of the few in existence some are open to grave criticism, as the men attending are too often permitted to give anæsthetics without an expert watching. It is too often forgotten that the fact that a man possesses a medical diploma or degree does not give any guarantee that he knows anything about anæsthetics or is a safe person to whom to commit a person about to be anæsthetized.

Lastly, I would urge that all modern students should be shown the more modern methods and, whenever possible, taught how to use them. I have known a man who, after listening to a lecture on "Modern Methods of Anæsthesia," rose to his feet and said, "For my part all I need is a pocket-handkerchief and a bottle of choroform. The only mixture in which I believe is 'chloroform and brains,' and I have practised for twenty years." And yet this gentleman had discarded what Thackery called "The light and airy costume of blue paint."—Woad.

INSTRUCTION IN ANÆSTHESIA IN THE GRADUATE SCHOOL OF MEDICINE OF THE UNIVERSITY OF PENNSYLVANIA

By Edward W. Beach, M.D.,
Associate in Anæsthesia.

INSTRUCTION in anæsthesia in the Graduate School of Medicine of the University of Pennsylvania is given by a separate department of the School and, as in all other departments, under the general authority of the Dean.

It is divided into three branches or divisions for teaching purposes—all under the direct control of a Director of Anæsthesia.

Taking each branch under separate classification will give more clearly the methods of instructions as follows:—

1. The Graduate Medical Student.

In this class are medical graduates who are desirous of making further study and increasing their skill in the administration of the various general and local anæsthetics. The applicant must be a graduate in medicine who has been accepted by the Dean as to his personal and medical qualifications; and during the course, which is of at least a month's duration, he is under the direct supervision of the Director of Anæsthesia and his assistants.

The course, a so-called "Personal Course," is so arranged as to give to the class as much instruction, both practical and didactic as is possible; and is so arranged that the student has regularly scheduled hours and may be called for night or emergency work arising during his period of study.

(a) *Didactic Instruction.*

This is in the nature of conferences given by the Director personally, which are composed of a series covering the theory and action of various anæsthetic agents. The conferences take up the chemistry and physiological action and the results of the administration of ether, chloroform, nitrous oxide,

ethyl chloride, ethylene and carbon dioxide as single agents, and their various combinations and sequences; various methods of induction and maintenance—as the open, semi-open, and closed— various special methods—as rectal, intranasal and intrapharyngeal—the advantages and disadvantages of the various methods; the general duties of the anæsthetist; the preliminary care of the patient; the care of the patient during and after operation; the indications and contraindications of the use of any general anæsthetics which may be given in a specific case; the accidents or disturbances which may develop during an operation, from the standpoint of the anæsthetic and the treatment or corrections to be instigated; the degree of responsibility to be assumed by the anæsthetist and his place in the team work of the operating room; the uses of local block and conductive anæsthesia—the advantages and indications—together with the practical application of such methods as the opportunity occurs.

(b) *Practical Instruction.*

This very important side of the instruction is, of course, carried on at the various hospitals and consists of demonstrations and the practical application of the theory as taught in the conferences. Each student physician is given as much instruction of this type as possible, in the different branches of general and special surgery. They have the opportunity to give the anæsthetic themselves and so become familiar with the handling of the agent as well as with the method of its administration. This is done under the direct supervision of the Director.

2. The House Medical Staff.

The instructions given the interns are along the same general lines as mapped out above and given the graduate students. Each intern cannot be given as much in the way of demonstrations because of the lack of time and material. The anæsthesia department, together with the Chief Resident Physician, endeavour to give each man a good working basis so that he may, when called upon, give a safe, satisfactory anæsthesia and to serve even in the difficult cases. Those interns who show special interest and aptitude are given more work, and so encouraged to progress in this branch of surgery.

3. The Nurse Anæsthetist.

This branch of the work is somewhat divided as to the instruction, but unified as to control. The hospitals have three resident nurse anæsthetists, who are registered nurses who have had special instruction in the art of skillful anæsthetization.

The didactic instruction to all head and pupil nurses is given by the Director of the department. It consists of the theory and action of all the general agents used, but because of the nurses' restricted knowledge of anatomy, chemistry, etc., the theory has to be somewhat limited. The practical instruction to nurses is given by both the Director himself, and the supervising anæsthetic nurses.

The course, which covers four months of continuous service, serves to give to the pupil nurses a fair working idea of the essentials of general anæsthesia, along with ability to handle most cases—and a knowledge of the duties, the care and necessary precautions for the safety of the patient.

One of the advantages of the working force of the Graduate School Hospitals is the fact that the Chief Anæsthetist is a member of the Major Hospital Staff. This allows him to hear and note any suggestions from the surgeons, and enables him to bring his problems to the persons most interested. He is given the authority to direct the policy of the department as to various agents used, the best type of apparatus and such matters as may better the conditions in this branch. Research is encouraged.

INSTRUCTION AT THE NEW YORK POST GRADUATE MEDICAL SCHOOL AND HOSPITAL

By T. Drysdale Buchanan, M.D.
Professor of Anæsthesia, and Director of the Department of Anæsthesia.

THE course in Anæsthesia given at the New York Post Graduate Medical School and Hospital consists of six lessons for which a charge of one hundred dollars is made by the School. It is open only to registered physicians.

General anæsthesia as applied to surgery and obstetrics

is taught by this department, those desiring instruction in spinal anæsthesia or regional anæsthesia can obtain the same from the Department of Surgery.

The course is elective, the matriculate choosing whether all six lessons be given in one method or whether the lessons will be given in two or more methods.

The lessons average one hour, giving ample time for oral instruction as well as practical demonstrations. The first hour is taken up by a description and demonstration of the inhalers used but this is omitted if the student is already familiar with the apparatus.

The second lesson consists of a demonstration by an actual administration during an operation, the instructor pointing out as the anæsthesia goes along, the various symptoms of the different stages and registering by reiteration the signs of over anæsthesia and danger signals.

The following lessons are taken up by the student administering the anæsthetic from the induction to the finish of the operation. The instructor standing by but taking no part in the administration unless the student is not following out the instruction.

In some instances the matriculate prefers not to administer the anæsthetic but feels that more information can be obtained by watching and questioning the instructor. This preference is usually respected, but a long experience in teaching anæsthesia has shown that most doctors applying for post-graduate work in anæsthesia, do so because of a lack of confidence in themselves to embark upon a new method without an experienced hand to guide.

For this reason they are put to the actual administration as early as possible and those who do actualy give the anæsthetic are apparently more satisfied with the course than those who prefer to be onlookers.

No attempt is made to give didactic instruction for it must be borne in mind that this is a post-graduate school and applicants for instruction are already proficient in the theory of anæsthesia and the physiological action of the various agents.

Students are, however, lectured to on the various methods of resuscitation, and, when the occasion arises, a practical

demonstration of these methods is given. In this connection students are always shown the proper way to introduce the various metal air-ways on the living subject and the use of carbon dioxide and oxygen as a respiratory stimulant. All students are taught that the character and rate of the respiration are the most reliable guides to the depth of the anæsthesia and that the pupillary and other reflexes are but confirmatory.

In instructing students one naturally brings up many points for discussion concerning preparation of patients, premedication, selection of anæsthetic agent, shock, after care etc. and the instructor is able to judge how much it is necessary to instruct that particular student in these matters

All instruction is individual, only one student being taken on a case, except the first lesson. Attempts at group instruction have not proved to be the best way in this particular specialty.

Most of the requests for instruction are for the newer methods or for the newer agents, so we have very little demand for work in drop ether but many wish to learn how to administer nitrous oxide ether sequence, nitrous oxide and oxygen, and ethylene and oxygen.

The methods covered by the Course are: open ether, chloroform, insufflation of ether or chloroform either by air or oxygen, ethyl chloride open or semi-closed method, nitrous oxide, nitrous oxide ether sequence, nitrous oxide and oxygen, ethylene and oxygen, carbon dioxide ether sequence, colonic administration of oil and ether, endovenous ether, pharyngeal insufflation of ether nasal or oral, and pharyngeal inhalation.

Owing to the fact that our surgeons rarely like chloroform or intra-tracheal anæsthesia used, the facilities for instruction in this method or the use of this drug are curtailed.

INSTRUCTION AT JOHNS HOPKINS MEDICAL SCHOOL BALTIMORE

By Professor E. M. K. Geiling and Miss Baise.

BY the time the medical student begins to study anæsthesia in his course in pharmacology, he has already had a series of lectures on the essentials of physiology. Dr.

E. M. K. Geiling, the Associate Professor in the department of Pharmacology, devotes six lectures and demonstrations to the principles of anæsthesia. An introductory lecture deals with the historical aspects of the subject. Mention is made of the contributions by Simpson, Long, Morton, Richardson, Wells and Paul Bert. As reference reading, articles by Chauncey D. Leake and H. H. Young and the chapter in Neuberger's history of medicine, are recommended. This is followed by a discussion on the different types of anæsthesia, namely, local anæsthesia, spinal anæsthesia and general anæsthesia. The anæsthetic state is defined as a "physiological condition in which normal reponsiveness, or automatic activity of the living organism is temporarily abolished or decreased," and this definition is enlarged upon. Attention is called to the fact that the change produced by the drug is reversible, unless the drug is used in too great a concentration, in which case, death occurs. The student is warned to use the smallest amount of the anæsthetic drug to produce the required depth of anæsthesia. Then follows a discussion of the chemistry of anæsthetics and the impurities present are enumerated. The concentrations of the various anæsthetics in the blood are given in tabular form. Next, the methods employed for the administration of anæsthetics are described—inhalation and rectal anæsthesia, in the case of volatile substances, local injection, spinal and epidural nerve blocking. The papers on spinal anæsthesia by Martin and Arbuthnot and on "Epidural anæsthesia in perineal prostatectomies" by Shaw, as also Halstead's contributions are suggested for reference reading.

The two anæsthetics in most constant use by inhalation methods, ether and chloroform, are discussed first separately and then in comparison. Dogs, cats and rabbits are anæsthetized with these drugs, demonstrating the initial reaction, and the subsequent stages passed through before complete anæsthesia is obtained. Dr. Geiling makes use of the tables given in McGuigans's Experimental Pharmacology to emphasize the various stages and the symptoms accompanying each step. The difference in the action of the two drugs become apparent in these demonstrations which lead to a discussion of the comparative usefulness and dangers of ether

and chloroform. The irritation caused by inhaling ether causes rabbits to stop breathing after the application of the cone, while chloroform fumes fail to have this effect. A dog may not exhibit the irritation to the respiratory tract as markedly as the rabbit, but shows a typical excitement stage with the beginning absorption of ether, which excitement will be less marked with chloroform anæsthesia. The behaviour of the cat emphasizes the narrow margin in both drugs between true surgical anæsthesia and a lethal dose; the cause of death is noted to be primarily respiratory failure in ether, whereas chloroform appears to paralyse the heart muscle. The student is instructed in the danger of delayed chloroform poisoning. At this time Dr. Geiling refers to the use of chloroform for the state of analgesia in obstetrics.

Having discussed these volatile liquids, the gases employed to produce the anæsthesia are taken into account. The first of these gases referred to is nitrous oxide and its use with and without oxygen. Its rapid and fleeting effect upon the organism is noted, as is its association with anoxæmia. It is demonstrated that the action of ethylene is similar to, but more potent than N_2O; also that oxygen deprivation is less marked and the sleep induced more like natural slumber than nitrous oxide anæsthesia.The student is referred to papers by Luckhardt and Carter on ethylene anæsthesia and to those by Halsey, Reynolds and Prout for a description of the anæsthetic properties of propylene, the newest of the anæsthetic gases. Brief mention is made of ethyl chloride, and of mixtures and sequences of anæsthetic drugs which facilitate administration or exert a synergistic effect.

Dr. Geiling takes up next, the recent chemical studies in anæsthesia. He quotes conclusions by Chauncey D. Leake in his paper entitled "Anæsthesia and Blood Reaction,"* also in his paper on "Acidosis of Ether Anæsthesia in the Dog," and on "The Effect of Ethylene-Oxygen Anæsthesia on the Acid-Base Balance of the Blood" and Blood Reaction in Ethylene and Nitrous Oxide Anæsthesia" A paper on "Blood Changes caused by General Anæsthetics" by Stannor is used in this discussion of recent studies. It contains tables of the CO_2, sugar, uric acid, lactic acid, phosphorus and NPN contents of the blood

* *Br. Jl. Anas.* Vol. II. No. 2.

of dogs before and after anæsthesia produced by chloroform, ether, nitrous oxide and ethylene. A similar study made by Brown and Henderson is noted.

The lectures end with a review of the theories of anæsthesia. Lillie's paper on "Theories of Anæsthesia" is found to be very comprehensive in dealing with this subject. Work by Henderson and Brown is discussed as described in their paper entitled "Theory of Anæsthesia and the Problem of Toxicity. Finally, the Myer-Overton hypothesis, to the effect that anæsthetic drugs owe their action to their solubility in lipoids and that their potency is in direct ratio to this solubility, is refuted by a demonstration of complete anæsthesia in a rabbit obtained with magnesium sulphate. The animal is tested for reflexes and is found to be in a state of deep narcosis, but immediately regains all normal responsiveness and activity on receiving an intravenous injection of calcium chloride.

Local anæsthetics are also discussed; attention is called to their more extensive use at the present time. The toxicity, mode of action and standards of comparison are mentioned. The advantages and disadvantages of some of the more common local anæsthetics are discussed.

In their further course in pharmacology each student is obliged to induce anæsthesia in one or two animals.

The literature referred to in the above text is placed at the disposal of these second year students. Dr. Geiling commented on the fact that these reprints were read by the majority of the class.

Owing to the interest stimulated by Dr. Geiling in the subject of Anæsthesia, the attitude of the third year man is one of keenness when the opportunity is given him to anæsthetize an animal. This opportunity is afforded him with an elective course in experimental surgery. The chief hospital anæsthetist supervises the anæsthetics given in this course. The method of anæsthesia used approximates as closely as possible the method used on human subjects, *i.e.*, the drop method. The attention of the student is called to individual reactions, variations in narcotic depth with different surgical procedures; he learns to anticipate moments that require stronger anæsthetic mixtures, as when the peritoneum

is closed, or traction is made on the cystic duct. Respirations and pulse rate are recorded and the amount of ether used during the operation is noted. The anæsthetics given in this course complete his instruction and practical experience in anæsthesia in the Medical School.

Anæsthesia at the Johns Hopkins Hospital is in charge of graduate nurses under the direction of the Chief of the Surgical Department. All anæsthetics in the hospital are given or supervised by this permanent staff. The anæsthetists are graduates of Nursing Schools offering a three years training, and complete a six months course in anæsthesia before they are eligible for positions on this staff. This course in anæsthesia consists of three months instruction in the administration of ether, followed by two months devoted to learning the use of the anæsthetic gases. During the last month only, is the pupil permitted to administer anæsthetics without supervision by a member of the staff. As only one nurse is admitted to the course at a time, the instruction in the principles underlying anæsthesia is individual and not confined to courses of lectures. Books on Anæsthesia are available for study, such as Gwathmey's, Flagg's, Poe's and Buxton's. If a nurse shows no interest in the psychology of anæsthesia and is unable to gain the confidence of her patients she is not allowed to complete the course. Regard for the state of mind of each patient and an effort to abolish their fear and apprehension are considered essential in an anæsthetist, but these points are not so easily taught, as is the purely mechanical induction of anæsthesia.

The surgical interne is assigned to anæsthesia for three to six weeks during his interneship, during which period he administers from 30 to 60 anæsthetics for major operations, supervised by a member of the anæsthetist staff. He is instructed in the use of straight ether, ether with nitrous-oxide-oxygen for the induction and in nitrous-oxide-oxygen throughout the operative procedure.

THE PROVISION OF AN ANÆSTHETIC SERVICE.

By Dr. J. STUART ROSS.

At the Annual General Meeting of the Scottish Society of Anæsthetists, held at Glasgow, July 6th, 1926. Dr. J. Stuart Ross read his Presidential Address on "The Provision of an Anæsthetic Service."

After welcoming the American visitors and emphasizing the necessity for improving the supply of skilled anæsthesia, both in the hospitals and in private, he explained the steps he had taken to ascertain what was being done to this end at the Medical Schools. A questionaire had been drawn up and circulated to the leading anæsthetists. No enquiries had been made in Scotland, as her representatives were present at the meeting to speak for themselves. Replies had been received from a large number of schools both in England and some of the Dominions.

The first question referred to lectures given to students. These were, apparently, universally provided and attendance was obligatory. Dr. Ross stated that he, personally, had always found six too small a number of class meetings; the number reported from the other centres varies from three or four, to a dozen. He regarded instruction in the applied physiology of the subject quite essential for the elementary teaching of students.

The second query elicited the information that in many schools, the subject was illustrated to the students by demonstrations upon anæsthetized animals. The action of the drugs themselves, and the causes of various accidents which might happen in the operating theatre were, he considered, made more clear to the student mind by this method than by any other.

The third point was the supervision of the student while learning practical administration to human patients. This was, of course, done everywhere by the visiting anæsthetists. Emphasis was laid upon the need for teaching to students the use of safe methods for minor surgery and for dentistry.

So deficient at one time was the teaching in Scotland to the medical student, that the Edinburgh Dental School had for many years educated its pupils to give their own anæsthetics. While the method chosen might not be equal to those rendered available by the constant presence of a fully trained anæsthetist, they were simple, safe and usually adequate.

In over sixty thousand administrations at the Edinburgh Dental Hospital, there had not been a fatality.

He considered that special instruction in anæsthetics should always be given to Residents immediately on, or better, before taking up office. In his own case, this was his first introduction to the subject, and even nowadays when every student received some training, extra tuition should be given to the Resident. From his fourth query, this was evidently generally recognized, although some schools which had instituted Resident Anæsthetists appointments, naturally did not need to give extra teaching to the other house officers.

Post-graduate instruction was the subject of the fifth question, and it was shown that opportunities were now available, particularly in London, for qualified practitioners to take a course under a skilled teacher.

The sixth, seventh and eighth questions were worded to elucidate the organization of the anæsthetic service within the hospitals. So far as could be seen, practically all the schools, including the Dominions, had included in their full staff, one or more of their visiting anæsthetists. He did not think, however, this was the case in any Scottish school, and he could not understand why they had withheld so long, proper recognition of men and women who devoted their lives to the speciality. In five of the London schools, one or more Resident Anæsthetists were appointed, and this appeared not only to have a marked effect in improving results (particularly in the emergency class of case) but also furnished the best possible training for one who wished to take up the subject as his life work. He suggested that no hospital had the right to offer a service of skilled anæsthesia for a few hours only; and that only by providing a twenty-four hour service, could the mortality rate be kept within reasonable limits.

It was considered that all this showed very sound work

and teaching, and as much of it was probably a comparatively recent development, the full results were likely to be apparent in the immediate future.

In private, the supply of skilled anæsthetists had certainly increased. Dr. McKesson had estimated in a recent paper that the number of persons doing anæsthetic work exclusively had increased, within the last few years, from four or five hundred to two thousand. The increase in Scotland would be more marked if more encouragement were given on the side of economics and a proper status in the schools.

As regards results from all these efforts, the best anæsthetist of to-day was certainly getting better results than the best that could be shown twenty, or even ten, years ago. Owing to the increased boldness and activity of the surgeon, the tax upon the anæsthetist's skill was greater now than ever before, and no figures could adequately show the lives saved, because no sets of figures referring to different periods were strictly comparable. One could only rely upon general impressions, but he could not doubt that vast improvement had taken place. If, however, one turned to the statistics of the Registrar General for England and Wales, and also the same for Scotland, the impression given was of progress in the wrong direction. A table was shown, illustrating the death rate from or under anæsthetics per hundred thousand population for the three pre-war years, and for all the post-war years he had been able to see. In England and Wales, there had been a rise since the war, but only from .8, to .9, which appeared to indicate, practically, the maintainance of the *status quo*. In Scotland, alas, there was a very substantial post-war rise.

Against the rate per hundred thousand population for each country for each year shown, he had placed in a second column a figure to represent the proportion of those deaths which happened under chloroform, or a mixture or sequence of which chloroform was a part. The exact significance of the figures of the second column was open to some doubt, but those of the first column could only mean one thing, which all Scotsmen would regret.

Mortality Rate for (a) England and Wales and (b) Scotland per 100,000 of Population, showing proportion thereof which

occurred under Chloroform or a mixture containing Chloroform.

	(a) England and Wales		(b) Scotland	
Year.	Mortality Rate per 100,000 Population.	Proportion of total anæsthetic deaths occurring under C.H.Cl.3 or a mixture containing it.	Mortality Rate per 100,000 Population.	Proportion of total anæsthetic deaths occurring under C.H.Cl.3 or a mixture containing it.
1911	.7	66%	.9	95%
1912	.7	52%	.9	94.5%
1913	.8	48.3%	1.0	87.5%
1919	.8	63.5%	.8	86%
1920	.9	52.1%	1.4	84.5%
1921	.9	44%	2.2	93.4%
1922	.8	46.4%	1.6	88%
1923			1.5	76%
1924			1.7	82.1%

These figures could not be considered satisfactory. They proved, he thought, not that anæsthetic science had deteriorated, but that the best possible was not sufficiently widely available, particularly in Scotland. He understood that the position had already been taken in hand seriously by one Scottish Hospital, which by adopting methods much like those indicated in the questionaire, had cut its death rate in half between 1922 and 1924, and bid fair to repeat the process this year. If one hospital could effect such a striking reduction in such a short time, it would be strange if the others could not, by taking thought, give a substantial contribution towards better results in the country generally which would tell its tale in the Annual Report of the Registrar General. He commended this point of view to the responsible authorities of the large hospitals.

At the conclusion of the Presidential Address a discussion followed:—

Dr. E. I. McKesson, (Toledo, Ohio.): To what has already been said, I should like to add a word of sincere appreciation for the very kindly reception which the Scottish Society has accorded the Anæsthetists from the States and Canada to-day—for the very interesting and instructive

demonstrations by Drs. H. P. Fairlie and J. Ross Mackenzie this morning. It is a very great pleasure to meet you here after having known of you for so long through the splendid work which has come out of Scotland in our speciality. The splendid paper of Dr. Ross reflects the common cause of anæsthetists everywhere—the universal nature of our problems, and undoubtedly shows the proper solution for the higher development of this service to the patient. A service which is as important to the wellbeing of the patient as anæsthesia must receive full recognition by the patient, which it does, but it must also receive the proper attention in the colleges and hospitals and recognition for its instructors. Not enough time in lectures and clinical practice is given in most colleges for the proper instruction in anæsthesia. Particularly is practical work under supervision important but, as pointed out, the student also needs to know the sciences underlying the subject and be acquainted with what has been done by others. Since reference has already been made to my work in this field of anæsthesia shall I venture to explain somewhat the methods used in instruction?

Since I am located in Toledo, Ohio, which is outside of a medical teaching centre it has been my lot to give post-graduate instruction only, which is entirely different as regards the type of student presenting than encountered in the Medical College. My students want to learn anæsthesia, having been in the practice of dentistry or medicine long enough to know the value of anæsthesia and the desirability of this field as a speciality .They are a hand picked group with intense interest, therefore, which more than the method of instruction, accounts for whatever success I have achieved. The plan consists of practical instruction in the use of nitrous oxid-oxygen etc. under supervision, and informal lectures and discussions of theory, of blood pressure and other reactions of technique for various cases which may be suggested either by the cases treated or hypothetical cases for illustration. Of the two divisions of instruction the supervised practice is by far the more important. The student is kept alert by intentional disorganization of his technique by turning off the gas or oxygen, by changing the mixture, the rebreathing or similar disturbing influences where he is not attentive,

making it necessary for the student to regain the proper control and to re-establish the desired plane of narcosis. It is obvious that the most cordial co-operation of the surgeon and anæsthetist is necessary for such instruction in anæsthesia. This is ours in Toledo. From my experience I belive that the best time to train anæsthetists is after, by experience in practice, the student has learned that anæsthesia is of great importance and desirable as a speciality. Although routine instruction of students and interest is necessary, one may rarely progress so far with them for reasons which are obvious to every teacher.

Dr. MARY E. BOTSFORD. (San Francisco.): The Chairman and Members of Scottish Association of Anæsthetists. It is a great pleasure to have the opportunity of expressing our sense of privilege in being present at this meeting and in listening to the very interesting paper just read. The Associated Anæsthetists of the United States and Canada have ever entertained the highest respect and admiration not only for the valuable work done in the speciality of anæsthesiology but as well for the professional standards required by the British in this field of medical practice. As to the comparative mortality rate referred to by Dr. Ross, statistics are notoriously unreliable—the determination of the cause of death accruing in the first twenty-four hours post operatively is often difficult and occasionally impossible. There is also the question of perhaps greater accuracy in reporting fatalities.

With our unfortunately lower standards in certain districts in the United States where technicians are used as anæsthetists, I am confident our mortality rate would exceed yours were chloroform used as frequently.

Dr. TORRENCE THOMPSON spoke of some of the difficulties met with in teaching practical anæsthetics to students. He referred to the large number of students that had to be dealt with in a short time—and to the fact that the interests of the patient must always be the first consideration.

He deprecated the giving of theoretical apart from practical instruction and said it was his custom to deliver six lectures at the beginning of each term to the students with whom he was to work in the operating theatre.

Dr. FAIRLIE joined with the President in extending a welcome to the guests from overseas. Their visit gave us all a valuable opportunity of exchanging views and comparing notes, not only during the more formal part of the days proceedings but also in the informal contacts and conversations which a meeting of the kind opened up. He congratulated the President in his stimulating address, feeling that Dr. Ross did well to stress the importance of the teaching of anæsthesia. He was very interested in the comparative way in which the subject had been approached, and to hear of the methods adopted for instruction in the various medical schools which had been mentioned. It was a fundamental matter and one which went to the root of many of the problems with which we are faced.

FRED L. NAPIER. Hon. Secretary.

Mr. S. R. Wilson, the Secretary and Treasurer of the *British Journal of Anæsthesia* has changed his address from "Ravensbourne," Anson Road, Victoria Park, to "Birch Croft" Dickenson Road, Rusholme, Manchester. Telephone unchanged.

Mr. Wilson has recently been appointed a Member of the Board of Faculty of Medicine of the Manchester University.

Dr. H. M. Cohen has been elected a Corresponding Member of the American Society of Regional Anæsthesia.

BOOK REVIEWS.

OUTLINES OF DENTAL SCIENCE. Volume I. "Dental Anæsthesia." By G. F. Rawdon Smith, M.D., and E. and S. Livingstone, Edinburgh, Publishers. 7/6 Net.

Dr. Rawdon Smith has succeeded in presenting the essentials of anæsthesia as they relate to Dentistry in this very attractive and compact output of the house of Livingstones. Not only will students find it invaluable in preparing for examinations, but practitioners of Dentistry may get from this little work more than they need for the average day's requirements. Though the great bulk of dentists rightly limit their anæsthetics to nitrous oxide gas and local injections, they will find the volume useful for reference as well as for keping up-to-date.

A SIMPLE PORTABLE APPARATUS FOR THE THERAPEUTIC ADMINISTRATION OF CARBON DIOXIDE.[1]

By H. Whitridge Davies, M.B., B.S. (*Adelaide*).
From the Department of Physiology, University of Leeds.

DURING the past few months considerable attention has been drawn to the value of carbon dioxide as a respiratory stimulant. The lectures of Professor Yandell Henderson[1] have given a clear indication of the advantages of the increased pulmonary ventilation obtained by this means in the more rapid absorption and elimination of volatile substances. The inhalation of air or oxygen mixed with approximately five per cent. of carbon dioxide promptly results in an increase of 300—400 per cent. above the normal pulmonary ventilation, and such mixtures have been repeatedly used in various types of reviving apparatus (for example, the "Edina" Carbogen apparatus[2] and the "Carbetha" apparatus[3] made by Messrs. Siebe Gorman & Co. Ltd.), with great benefit in cases of carbon monoxide poisoning.[4]

A quantitative study of the effect of various percentages of carbon dioxide upon the pulmonary ventilation has been made by Davies, Brown and Binger.[5] From consideration of the work of these and other writers it may be stated that under normal circumstances, the amount of air breathed by an adult of average size is approximately seven litres per minute. If, however, the inspired air contain five per cent. of carbon dioxide, the respiratory minute volume will be approximately thirty litres. This greatly increased amount of air breathed acts as a larger vehicle for the conveyance of normal or even increased amounts of ether to the lungs at concentrations much lower than those which produce laryngeal spasm or pulmonary irritation.

1. The work described in this paper was done while the writer was in the Department of Therapeutics, University of Edinburgh.

Moreover, the greatly increased depth of breathing brings into action a much larger area of lung surface for the absorption and elimination of ether or other volatile substances. Carbon dioxide acts extremely promptly, the maximum effect being obtained within ten seconds of commencing the inhalation, and this action lasts so long as the subject continues to breathe the mixture. This prolonged effect is in marked contrast with that produced by such measures as ammonia, or the application of cold or mechanical stimulation to the skin. Carbon dioxide has also advantages in that the increased pulmonary ventilation is obtained without any great increase in metabolism. This is in contrast with the effects of such substances as strychnine and caffeine, where the increase in pulmonary ventilation is only slight (10—15 per cent. at most) and largely secondary to increased metabolism (*i.e.* greater demand for pulmonary ventilation).

Carbon dioxide, then, is a powerful and valuable respiratory stimulant, and it is useful not only to expedite the absorption or elimination of anæsthetics or other volatile substances but also in conditions of respiratory failure and respiratory depression such as are met with in shock, anæsthesia narcotic and alcohol poisoning, obstetrical work, carbon monoxide poisoning, and submersion. The possible objection that carbon dioxide will asphyxiate the patient is not valid. Asphyxia consists in two elements, carbon dioxide retention and oxygen lack, oxygen lack being the deadly one. When ordinary atmospheric air is mixed with five per cent. of carbon dioxide, the oxygen percentage falls only from 21 per cent. to 20 per cent., and when this mixture is breathed, owing to the greatly increased pulmonary ventilation, the percentage of oxygen in the alveolar air of the lungs is actually *raised.*

With the deep respirations produced and maintained by the addition of carbon dioxide to the inspired air full surgical anæsthesia can be produced in from five to six minutes with *ether alone*, administered by the open method.

If in addition a second dose of carbon dioxide (two litres per minute added to the inspired air for about five minutes) is administered at the end of the operation, ether is eliminated rapidly and the incidence of post-anæsthetic vomiting has

been found to be greatly reduced.[1] Owing to the rapid return of consciousness this second dose is best administered after the patient has been returned to bed. Carbon dioxide also affords to the anæsthetist very great assistance in rapidly deepening or lightening the anæsthesia when required during the course of an operation, and in overcoming the respiratory irregularity which frequently occurs when a patient is placed in the Trendelenburg position. Owing to the greatly increased amplitude of respiratory movements produced by carbon dioxide, its use is contra-indicated during the course of operations on the upper abdomen. In such cases, however, it may be used to aid the induction of anæsthesia and for rapid de-etherization at the end of the operation.

Normally, the respiratory response to carbon dioxide consists in markedly increased depth of breathing, the rate being only slightly affected. In a small percentage of cases, however, there is marked increase in respiratory rate with no increase or diminution in depth. In such cases the administration of carbon dioxide must immediately be abandoned. A tendency to rapid shallow breathing is a symptom of a type of respiratory instability which renders the patient a very bad subject for anæsthesia. This response of rapid shallow breathing affords a timely warning to the anæsthetist to proceed cautiously and its dangers may be largely overcome by the free use of oxygen.

The use of mixtures prepared in cylinders and containing five per cent. of carbon dioxide is not satisfactory in practice, as it is necessary for the subject to breathe such a mixture undiluted, and with the greatly increased pulmonary ventilation such a rapid flow of the gas is necessary that even the largest size cylinder (100 cubic feet) would not last very long. The same results can, however, be obtained in practice by adding a gentle stream of pure carbon dioxide (oxygen may be added as well if so desired) to the inspired air. The amount to be added depends upon the size of the patient as well as upon the amount of increase in pulmonary ventilation desired. It has been found, however, that pure carbon dioxide added at the rate of 1½—2 litres per minute to the inspired

1. Data on a series of cases proving this point are being prepared for publication by the writer in colaboration with Dr. R. V. Christie.

air will treble the respiratory minute volume of an adult patient of average size. The resultant concentration of carbon dioxide being very nearly the optimum five per cent. In order to gauge the rate of flow, some form of flow meter is desirable, but, as the respiratory response is almost instantaneous and easily observed, this hardly seems necessary.

The amount to be administered, then, is the minimum which will produce the desired amplitude of respiratory movement. One must, however, at this point observe that a sudden rush of pure carbon dioxide, if inhaled, would produce unpleasant symptoms of irritation and might even produce a temporary spasm of the glottis. It is necessary, therefore, to have some reliable means for delicately regulating the flow of gas, and of assuring a gentle, steady stream which can be increased gradually until the desired amount of respiratory stimulation is obtained. It is, perhaps, scarcely necessary to point out that in conditions where the breathing has ceased altogether, artificial respiration must be carried out in order that sufficient carbon dioxide may be absorbed to stimulate the respiratory centre.

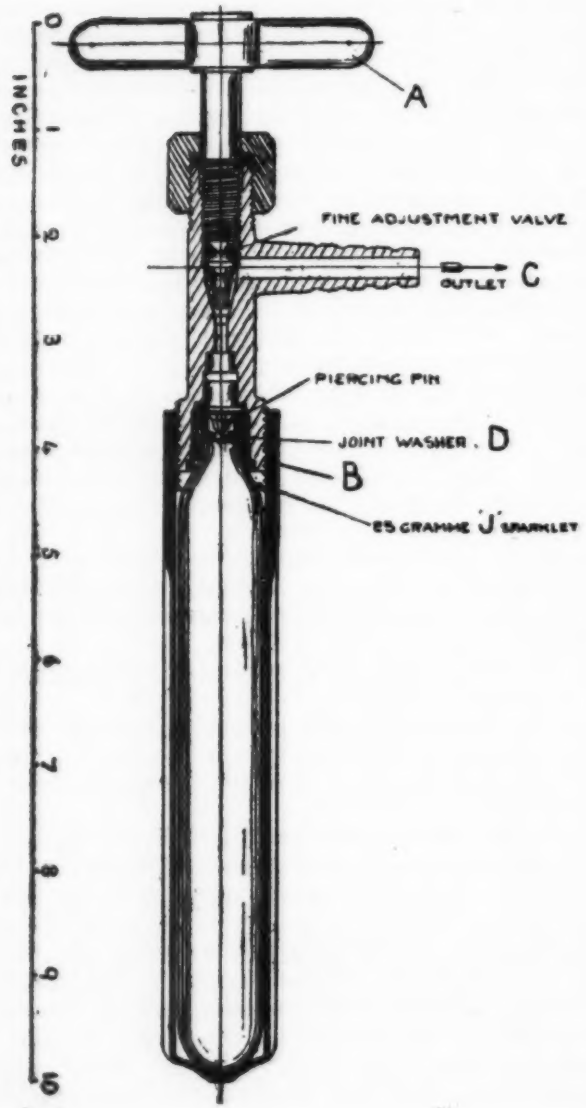
In view of the above consideration it seemed that a simple portable apparatus for the administration of carbon dioxide might be useful. Such an apparatus must fulfil the following conditions:—

(1) It must provide an adequate and readily obtainable supply of the gas.

(2) The means of regulating the flow of the gas must be so delicate that a steady, easily controlled stream, at rates up to two litres per minute, can be relied upon.

(3) It must be sufficiently small to be carried easily with other apparatus in an ordinary hand bag.

With the kind co-operation of Professor Briggs, of the Department of Mining, University of Edinburgh, and of Messrs. Sparklets Ltd., an apparatus has been devised which fulfils these conditions. The stock "J" size Sparklet bulbs are six and a quarter inches in length and slightly more than three-quarters of an inch in diameter. Each contains 25 grammes of liquid carbon dioxide, which would provide approximately, 12 litres of the gas. This, at a maximum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JOINT WASHER
D
B
ES GRAMME
J
SPARKLET

rate of flow of two litres per minute, would last for a period of at least six minutes. With this available supply of carbon dioxide it was necessary merely to provide a suitable holder incorporating a perforating device and a regulating valve. This was designed by Messrs. Sparklets Ltd., and is shown in the diagram.

The apparatus is used as follows:—The needle valve is closed by screwing down "A." The holder is then removed by unscrewing at the joint "B," and a Sparklet bulb inserted into the holder. This is then again screwed on to the head. On screwing up, the end of the bulb engages tightly in the rubber collar "D," and the bulb is punctured, allowing the gas to issue at the outlet "C" when the needle valve is opened by unscrewing "A." From "C" the gas is delivered by means of a piece of thick walled rubber tubing, the end of which can either be attached underneath an ordinary Schimmelbusch mask; placed in the patient's mouth; attached to a glass funnel; or attached by means of a suitable connector to a rubber catheter passing to the naso-pharynx of the patient. If so desired, the gas can be delivered through a small rubber bladder: this serves to equalize the flow, and roughly indicate the quantity of gas being delivered. It has been found, however, that the needle valve "A" is sufficiently delicate to supply a gentle, steady, easily regulated stream, thus, after a little experience, obviating the necessity for the rubber balloon. When the supply of gas is exhausted, a refill can be quickly inserted.

The length of the apparatus is ten inches, its maximum width three and a quarter inches and the diameter of the holder one inch. This, together with half a dozen refills, is not a formidable addition to the contents of the midwifery or anæsthetic hand-bag of the practitioner.

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REGIONAL AND SPINAL ANÆSTHESIA

REGIONAL ANÆSTHESIA IN THE EUROPEAN CLINICS*.

By C. A. O'Dén, M. D.

DURING the year 1925 and early 1926 it was my good fortune to visit various surgical centres of Europe, and, because of special arrangements I was permitted to come in close contact with and often assist several of the Master Surgeons who used regional and local anæsthesia.

I learned to appreciate the methods used in a peculiar manner. In but a few of these Clinics did the surgeon make the injections, as the patient was already prepared and injected, ready for operation, before he began his work. The anæsthetist was one especially trained for his work and as a result, the anæsthesia was skillfully administered. In several of these Clinics it was interesting to note the wide range in which local anæsthesia was employed and the universal effectiveness present. Goitre, thoracic, gastro-intestinal surgery, as well as that of other regions, was all done with the same favourable results. One factor which proved to be a real essential was the exact knowledge of regional anatomy possessed by all who undertook this work.

I spent several months in the Maria Hospital in Stockholm, as a special guest and assistant to the eminent surgeon Einar Key, Professor of Surgery, Caroline Institute, without a doubt, the peer of Scandinavian surgeons. As Lennander, who perhaps did more than any other in the line of research

* This and the following papers were read at the meeting of the American Society of Regional Anæsthesia, Oct. 5th, 1926, New York Academy of Medicine.

of nerve innervation, especially that pertaining to the sensory nervous system, was formerly a teacher at the University of Upsala, one does not wonder at the knowledge of this special work possessed by the Scandinavian surgeons. This discovery of the absence of sensation of visceral peritoneum as compared to a hypersensation of the parietal peritoneum made it possible to use local or regional anæsthesia in abdominal surgery with perfect safety and comfort.

In Professor Key's Clinic, local anæsthesia was used almost exclusively in all goitre operations. His technique varied from the surgeons of the Continent in that he depended upon nerve infiltration rather than individual nerve blocking, thus rendering the procedure safer and less complicated. One important rule in all injections was to be absolutely certain that no blood vessels were punctured; this was easily determined by using back suction and never injecting fluid while introducing the needle.

About two years ago I perfected an attachment for the Meeker and Labat syringes which permitted continual injection and suction of anæsthetic fluid. After demonstrating this to Professor Key, he made constant use of this apparatus in his work with entire satisfaction. The anæsthesia produced in goitre surgery done at this Clinic was very effective, but aside from this no further comment is necessary.

In the field of thoracic surgery, however, there are several phases which are of interest and importance. Because of the condition of the patient and the pathology usually present, excepting for the occasional use of narcilyn, which corresponds to the ethylene used in this country, general anæsthesia was seldom used. Local anæsthesia was the method of choice. The first step of the operation consisted in a subdermal injection along the line of intended incision, no attempt being made at this time to inject the intercostal nerves, until the exposure had been made; another reason for this step was to avoid the great danger of infection which might be possible by direct injection from the outside surface. Each individual nerve was located prior to its injection and as a consequence the effectiveness was immediately apparent and necessitated the use of only a small amount of the anæs-

thetic fluid. One half to one per cent. novocaine solution was employed. This same procedure was followed in the various steps of the operation whether it was done in two or more stages, until completed. The results obtained were convincing of its effectiveness.

Embolectomies, one of the outstanding features of this Clinic, were all performed with local anæsthesia, with blocking, infiltration, or both, depending upon the anatomical site involved.

In Professor Petren's Clinic, University of Lund, about 50 per cent. of all operations were performed under local and regional anæsthesia. Frequent operations on the gastro-intestinal tract were performed with satisfactory results. After injecting the abdominal wall and parietal peritoneum as indicated for the individual region to be operated, the viscera could be dealt with, with practically no additional anæsthesia because of the peculiarities of the sensory nerve fibres in this tissue.

Where an extensive work was to be carried out, especially in stomach surgery, the lesser omentum was injected at its base, utmost care being used to make the injection along side and not into the vessels. This was accomplished by using a short needle on a cannula passed along the side of the index finger *in situ* and making certain that no vessel was punctured. The appearance of a single drop of blood was indicative of failure and the procedure had to be repeated or abandoned. The same precaution applied as in using the splanchnic anæsthesia. The Bilroth operation was the method of choice in this Clinic.

In Copenhagen, ether was the anæsthesia of choice, so nothing of importance can be reported in this regard from Rovsing's Clinic. I spent only a short time in Sudek's Clinic, Hamburg. In Von Schmeiden's Clinic, Frankfurt, A.M., anæsthesia was used extensively, but nothing unusual was noted during my limited stay here.

On the other hand, it was my good fortune to spend some time with Professor Braun of Zwickau, Germany, the father of local anæsthesia, and here the fundamental principles so necessary for its effectiveness were demonstrated to the minutest detail. Professor Braun was very courteous and

personally demonstrated methods he used for special local injections, going into details in explaining his technique. His classical monogram pictures all this very vividly. I would recommend that every anæsthetist and surgeon acquaint himself with this volume. Suffice it to say his technique was beautiful and perfect, consequently very effective.

Through the courtesy of several surgeons of Scandinavia and the Continent I received special privileges from Professor Von Eislesberg of Vienna.

He explained the various methods used in his Clinic and special instructions in the technique used were given me by his first assistant. It was quite interesting to note that he did not support the type of splanchnic anæsthesia advocated by Finsterer, because of the danger and length of time it required for each operation.

As in Professor Petren's Clinic in Lund, Von Eislesberg laid great stress upon completely injecting and anæsthetizing the outer abdominal wall and parietal peritoneum and repeatedly demonstrated that merely injecting the lesser omentum sufficed to produce anæsthesia of the abdominal viscera. The condition of the patient during and after operation was conclusive of its safety and effectiveness. Gastro-intestinal surgery predominated in this Clinic.

In Professor Sauerbruk's Clinic at Munich, extensive thoracic operations were performed with the use of local anæsthesia; each operation included several stages: the injections made depended upon the individual portion of the operation performed. His technique was almost identical with that used and observed so extensively in Stockholm. The results from the serial stage operation as compared with the one stage were so favourable that the latter has been entirely abandoned. Individual nerve injection instead of massive infiltration made it very effective.

In the various Clinics of Switzerland a great majority of all the goitre surgery was done under local anæsthesia. In Professor Hatz's Clinic, Basil, a special type of injection was used; at his request his anæsthetist showed me the fundamental principles involved and the steps carried out. Twenty c.c. of a two per cent. novocaine solution was used, consequently no edema of the tissues. His technique is a

combination of nerve block and infiltration. The nerves supplying the field of operation only are to be anæsthetized; all injections were made previous to starting the operation in an adjoining room. For bilateral resection three points were selected for skin perforation. Preliminary injection is made with a fine needle.

Point 1. Infiltration is made opposite the superior border of the thyroid cartilage at the posterior border of the sternomastoid muscle, superficial to the sheath of the sternomastoid muscle. The main trunk of the transversalis coli nerve passes through this area to supply the skin from the level of the thyroid bone down to the level of about an inch above the suprasternal notch.

Point 2. At the middle, and external to the thyroid cartilage, the needle is directed to the external border of he cartilage, and an infiltration is made around the superior thyroid pole; two nerves are anæsthetized. the one passing from the superior cervical sympathetic ganglion to the superior thyroid artery, and a nerve branch from the external division of the superior laryngeal nerve, which enters the gland capsule internal to the same artery. Less shock is produced during the operation by blocking the sympathetic nerve. The branch from the laryngeal is necessarily a nerve of ordinary sensation. Much pain is caused at the upper part of the lateral lobe if the infiltration has been faulty at this point.

Point 3. The needle is directed forward under the skin about one finger above the clavicle between the borders of the sternomastoid muscle to make a subcutaneous infiltration below and parallel to the intended line of incision; this anæsthetizes terminal nerve branches which come to the skin from below; just above the clavicle and upper border of the sternum.

Of course I visited Berne. Berne is the Mecca for goitre surgery. The late Professor Kocher made it such. His student and successor, Professor DeQuervain, has taken up his mantle and continues the work of his master. He used local anæsthesia almost exclusively in all his operations. Larger amounts of anæsthetic fluid similar to that described in Labat's Text-book for Cervical Block were used.

In Professor Bastianelli's Clinic in Rome, spinal anæsthesia was used in a large percentage of abdominal and pelvic surgery. I have purposely avoided referring to the use of spinal anæsthesia in other Clinics as this is a different subject. The observations made of regional and local anæsthesia were quite satisfactory. As mentioned before, one of the main requisites for its satisfactory use is the possession of an accurate knowledge of anatomy. When this and the necessary principles involved are at the command of the operator, the results are usually good.

Discussion of Dr. O'Dén's Paper.

Dr. Wertheim: There is one point that Dr. O'Dén has not sufficiently stressed, and that is embolectomies as a surgical procedure removing emboli and thrombi from the larger vessels. The doctor has told us that in the European clinics this procedure is carried on extensively. In this country I know of but very few men who use this surgical procedure in indicated cases. This is a field for open discussion, and I trust, at a future date, that Dr. O'Dén will acquaint us more with the technique of this method.

Dr. Labat: Dr. O'Dén has presented us with a very nice description of what he has been able to gather from his European tour, and he has certainly impressed us with the statement that they are using more local and regional anæsthesia than we are here, and the more so for operations such as require the injection of the intercostal nerves. Paravertebral injections and other nerve blocks are done by the open method most of the time. The fear that infection may be carried from the surface to the deeper structures is, I think, a little exaggerated, for we generally paint the patient with iodine or other antiseptic solution and obtain as clean and aseptic a surface as possible.

Dr. O'Dén's is also interesting in that it shows us how much regional anæsthesia is used in goitre operations performed on the Continent, particularly with the special technique in which three points of injection are utilized,, as described by the speaker. We are very thankful to Dr. O'Dén for his paper.

STRICTURE OF THE URETHRA.

(The use of Sacral Anæsthesia).

A Preliminary Report.

By Winifred Scott Pugh, M.D.,

THERE is an old urological maxim that local anæsthesia should never be used in an attempt to dilate a stricture of the urethra. This has probably saved many a urethra from severe trauma at the hands of the inexperienced physician. To the one who understands the delicate structure of the urethra and treats it accordingly this old adage means nothing. We confess that during the past twenty-six years we have used local anæsthesia quite liberally in stricture as well as in other urethral lesions.

In a very large series of local anæsthesias given for operations on the lower urinary tract, the relaxation of the perineal stricture has been marked. This is particularly striking in that section around the bulbo-membranous junction, the most frequent location of urethral stricture. This is not only noted in adults, but we have also seen it in about sixty cases where sacral anæsthesia was used in children.

Technique.

The sacral injections are made in the usual manner, namely, the skin is prepared with picric acid solution. We prefer this as it does not obscure the vision quite so much as iodine. We use the Luer Lok type syringe and a small needle. These needles have the advantage that they can be bought in any drug or instrument store. The wheal is then incised over the sacral hiatus and the needle withdrawn. We then enter the sacral canal with a three inch needle, injecting about 30 c.c. of one per cent. novocaine. I do not think it makes any real difference if one uses suprarenal or not. Some seem to think that this drug causes trouble; we have not seen it, even in a large series of cases. Our only difficulty in the use of suprarenal has occurred in circumcision cases. In those cases there was practically no oozing at the time of operation, but it certainly occured later.

With this slight digression we will go on to the treatment.

We have found it wise to wait about fifteen minutes after the needle is withdrawn and then proceed to the urethra.

Types of Cases.

We have up to the present confined the use of this method to strictures of small calibre. By that we mean cases in which we had hitherto been unable to pass any instrument, or at best a filiform into the bladder. The procedure is then to introduce three or four whips of the Phillips or the Lefort sounds in the urethra down to the stricture. Very gentle attempts should then be made to pass the instrument. In every one of our cases (impassable previously), we were able to enter the bladder. The relaxation which takes place is sometimes so marked that a much larger elastic catheter of the graduated type can often be passed at the same sitting.

As this article is only in the nature of a preliminary report, we shall not discuss the anatomico-pathological conditions, but limit our further remarks to case reports. (Several cases are reported).

We have found the study of these cases of very great interest, as we believe it opens up an entire new field. A thorough investigation of the literature has revealed no research work on the lines laid down in this paper. Stricture of the urethra is by no means so common as formerly. This is not by any means intended to infer that there is less gonorrhœa than formerly. On the contrary, we believe that as the result of our paternalistic laws, the gonococcus is more widely distributed. The educational programme which has been carried out, however, has been of value, in that we see our cases much earlier and we have, therefore, less stricture. The urologist undoubtedly sees more strictures than the general surgeon and when we do see them, they are just as bad as of yore. We hope the method we have suggested will be found of aid in robbing urethral stricture of some of its terror.

Discusssion of Dr. Pugh's Paper.

Dr. Robert B. Anderson: In most of my urological work for the last three or four years, I have used nothing but local anæsthesia. One thing is certain, that caudal block will relieve a lot of spasm of the urethra. Strictures that

permit no filiform to pass are treated by external urethrotomy. We use for caudal block a two per cent. solution unless the patients are in very bad shape, and if excitable, morphine is given them.

The writer of the paper is to be congratulated on bringing this subject before use, because it certainly helps us with many a bad case. Thus, in bad peri-urethral extravasations when blocked, a tube can be gotten into them, and their extravasations drained, and the patient returned to living conditions with far less shock than when general narcosis was used for anæsthesia.

Dr. CAMPBELL: We have made the same observation already noted by previous speakers, that you do get a local relaxation by the simple use of novocaine, 10 per cent., in the urethra. This gives both relaxation and relief from pain for the ordinary urethral instrumentations.

Dr. PUGH: This little sketch was presented merely as a preliminary report, representing a line of research work which has been carried on for the last two years. We hope that members of the Society who have much more opportunity of carrying on regional anæsthesia than I do will take it up and elaborate on the subject.

SPINAL ANÆSTHESIA[1]

A STUDY OF ITS USE IN 536 CASES.

By MEREDITH F. CAMPBELL.

Attending Urologist, Broad Street and Lincoln Hospitals; Assistant Visiting Surgeon, Cancer Institute; Adjunct Urological Surgeon, Bellevue, New York.

The historical background and general technique of spinal anæsthesia are so well known to those present that I shall confine the content of this report to a study of this form of anæsthesia in 536 cases in the Urological Service of Bellevue Hospital.

Previous to 1920 this anæsthesia had been used in the

1. From the Urological Service of Bellevue Hospital.

Bellevue Urological Service in a few cases, but two fatalities immediately following its use—both occurring within a relatively short time—caused its abandonment. In 1920 spinal was resumed in that five patients were so anæsthetized. Since then we have come to use it more and more, so much so that with our extensive use of spinal and local, comparatively few general anæsthetics are administered.

For our work as urological surgeons, spinal is the ideal anæsthetic. Most of our patients are nephropathic; in many the renal damage is extreme. Many are hypertensives; these bear spinal admirably. To date we have not perfected our technique to that point whereby nephrectomies may be painlessly performed. Parenthetically we might add that we have never seen an entirely painless nephrectomy performed under regional anæsthesia of any type. When the renal pedicle is clamped, pain may be exquisite. We have found by recent work, however, that the use of the double or so-called split spinal gives more satisfactory results, particularly for bladder work and suprapubic prostatectomy.

Pre-Operative Preparation.

Before being sent to the operating room, our patients receive morphine sulphate, gr. ¼, and atropine gr. 1/150 in addition to a liberal fluid intake. We feel that the sedative is mandatory in any case before attempting operative procedures on the conscious patient.

Technique.

We give spinals both in the upright and in the prone positions, the former being preferable. The patient assumes an elbows on the knees posture over the edge of the operating table. Local anæsthesia through the dura is used in all cases. This insures a painless and quiet lumbar tap. For most of our work injection is made in the third lumbar space. The average dose is 80 mgm. novocain crystals dissolved in about 3 c.c of spinal fluid. Both the withdrawal of the spinal fluid and the reinjection of the spinal fluid-novocaine mixture is done slowly and without barbetage. The finer the needle, the less the danger of dural leakage following withdrawal of the needle and by the same token, the fewer the undesirable sequellæ which occasionally follow.

The Double or "Split" Spinal.

Comparatively recently we began using the double or split spinal. We have asked Dr. Rubin, Resident Urologist at Bellevue, to speak of this type of regional anæsthesia as he has been particularly interested in observations in this field. To date our series of these double spinals is small and it is rather to note that we are using the method than to make a report that we mention this phase of spinal work here. A report will be forthcoming when we have used it on a greater number of patients.

When using the double spinal, injection is made in the 12th dorsal and also in the 3rd lumbar spaces. As is known, the object of this is to obtain anæsthesia comparable to that obtained with transverse section of the cord. It is known that the novocain solution does not permeate the cord itself in entirety but rather limits itself to the efferent and afferent roots. The lower injection blocks at the point of their emergence in the region of the cauda equina those fibers which were centrally located in the cord at the site of the upper injection. This form of anæsthesia is especially valuable in the painless performance of suprapubic prostatectomy, since it allows free and energetic manipulation of the enucleating fingers within the bladder and posterior urethra as well as a two-finger dilatation of the rectum when it is necessary to have aid from below during an arduous enucleation.

Indications and Contraindications.

The patient in sound body is the best risk for spinal. For operative procedures below the diaphragm this anæsthesia is ideal. Hypertension rather suggests the use of spinal since these cases do especially well. There is usually a drop of blood pressure (average10-30 mm. mercury), and is well borne by hypertensives even though suffering from grave cardionephropathies. On the contrary, hypotension—a blood pressure below 100 mm.—is a definite contraindication as is extreme toxicosis or a moribund status. The anticipation of an unusually long anæsthesia sometimes contraindicates although we have often carried a case for an hour and a half when the anæsthesia wore off, then completed with gas. Marked embarrassments to the cardiac or respiratory functions

may deter one from using spinal. It should not be used in the presence of spinal disease or brain tumours, particularly cerebellar growths. Previous spinals do not contraindicate for we have used it six times on one patient and Babcock reports its use twelve times on a patient of his.

Bellevue Cases.

During the past seven years spinal anæsthesia has been given 536 times for operative procedures on the Urological Service at Bellevue Hospital. The ages of the patients are shown in Table II. The youngest was fifteen, although we have given it twice in one week to a twelve years old boy elsewhere. Some have reported successful use in children as young as four years. Our oldest patient was 87.

The number of cases operated upon with the various forms of anæsthesia used and the relative mortality of each are shown in Tables 2 and 3. Two of our patients went into shock following spinal, from which they did not recover. Both were extremely toxic, essentially moribund, one with an extensive urinary extravasation, the other suffering from an enormous periurethral abscess. Each should have had local anæsthetic, if any, for surgical procedure and the administration of the spinal unquestionably hastened their deaths.

A comparison of our mortality with general and spinal reveals a difference of about 4 per cent. in favour of spinal. To ascertain whether this was generally true in our cases we made an analysis of cases of a more or less general type—those requiring external urethrotomy for relief. Those patients having general anæsthesia in 1920 and 1921 when we used spinal but little, and those who had spinal in 1925 with those few having it in 1921 (when we first began using it) were chosen for comparison. Here, too, the difference of about 4 per cent. mortality in favour of spinal is noteworthy. The ratio between immediate pulmonary complications with general and spinal was 7 to 1. (See Table 4.)

Most of these patients were admitted in a semi-uremic state, often with extreme renal impairment. Many secreted no phenolsulphonephthalein in two hours. They were at best poor surgical risks. The data obtained from this study of a relatively small series of cases of a general type seem to

indicate rather definitely that there is a slight mortality rate (4 per cent.) in favour of spinal anæsthesia.

Complications.

Cardiovascular and respiratory complications are encountered occasionally, but are nearly always of a type suggestive of bulbar anæmia. Clinically confirmatory of this observation is the fact that Trendelenberg position most frequently restores these functions to normal. For marked vascular disturbances, adrenalin is the drug of choice. Caffein is perhaps the best medication for respiratory embarrassments. Cases have been reported in which artificial respiration was necessary. To date we have not seen much although at times vascular disturbances prove temporarily alarming.

Complications as noted by us in this series are shown in Table 5.

Table I

Age	10—19	20—29	30—39	40—49	50—59	60—69	70—79	80—
Cases	7	103	129	99	100	59	20	5

Table II

Total operative mortality	8·0 per cent
Local operative mortality	4·0 per cent
General operative mortality	12·2 per cent
Spinal operative mortality	7·8 per cent

Table III

Diagnosis	Stricture	Periurethral abscess	Prostatic abscess	Extravasation	Miscellaneous	Total
Gas Oxygen Ether 1920 and 1921						
Cases	65	21	14	14	4	129
Death—						
Sepsis	3	—	—	2	—	5
Uræmia	1	—	—	1	—	2
Pneumonia	2	—	1	4	—	7
Mortality 10·9 per cent.						
Spinal, 1921 and 1925						
Cases	70	35	19	4	10	138
Death—						
Sepsis	2	—	3	2	—	7
Uræmia	2	—	—	—	—	2
Pneumonia	—	—	1	—	—	1
Mortality 7·2 per cent.						

TABLE IV.
TYPES OF ANÆSTHESIA AND RELATIVE MORTALITY OF EACH.

	1920	1921	1922	1923	1924	1925	1926[1]	Total
Operations performed	624	623	632	655	574	550	420	4088 [2]
Local	290	331	298	267	254	258	183	1881 [2]
General	329	255	301	297	206	172	111	1671
Spinal	5	37	33	91	114	120	126	536
Operative Deaths	40	45	61	42	57	49	27	321
Local	9	7	18	7	9	19	9	78
General	30	36	41	33	36	17	8	201
Spinal	1	2	2	2	12	13	10	42

[1] January—September inclusive.
[2] Including 15 spinals for cystoscopy.

TABLE V.
COMPLICATIONS OF SPINAL ANÆSTHESIA.

Fatal shock (both moribund)	2
Headache (longest 10 days)	3%
Cervical rigidity (meningismus)	2
Transient respiratory difficulty with occasional nausea	1
Vomiting	2
Meningitis, convulsions, urinary incontinence or retention, cord trauma, ocular palsies	0
Broken lumbar puncture needle	1

SUMMARY.

For operative procedures below the diaphargm, spinal anæsthesia serves admirably, particularly in those cases in which there is renal impairment. For our work as urological surgeons it is the ideal anæsthetic except in the hypotensive patient.

Spinal has its definite indications and contraindications as have all other forms of anæsthesia; a low blood pressure is the chief contraindication.

From a limited observation, the double spinal seems to hold great possibilities, particularly for bladder surgery.

Occasionally undesirable sequellæ follow the use of spinal anæsthesia.

In our series the mortality is about 4 per cent. less with spinal as compared with general anæsthesia.

33, East 68th Street, New York City.

DISCUSSION OF DR. CAMPBELL'S PAPER.

Dr. ELIAS RUBIN: For the past few months at Bellevue we have been doing some work on the so-called "split" spinal anæsthesia. For a period of over five years, spinal anæsthesia has been used quite successfully as Dr. Campbell has

described, but most of our work has been on the male perineum, strictures, prostatic abscesses, and so forth. We of course knew of the work of spinal anæsthesia when the injection was given at higher levels, but not many men were using it. We thought we should like to use spinal anæsthesia in suprapubic work, in kidney work, in ureter work, and in work on the testes and cord, like epididymectomies and orchidectomies. We had noticed giving the regular spinal anæsthetias between the third and fourth lumbar spaces that sometimes the anæsthesia would extend as high as the umbilicus, and then sometimes, but very rarely, the anæstheia would extend as high as the nipples. Most of the time anæsthesia up to the umbilicus was not obtained, and very often in doing the operation for extravasation, the perineal work was done very well without trouble, but in incising the groin and going up on the abdomen, the patient began to complain of pain. Yet we knew that we did not get anæsthesia regularly high up with a low tap. We then tried injection between the 12th dorsal and the first lumbar space for operations on the bladder, prostatectomy, etc., and we found that we got good anæsthesia for the abdominal wall, but when enucleation of the prostate was attempted, or an insertion of two fingers into the rectum, then the patient did complain. Similarly if we tried a high injection for an epididymectomy, the anæsthesia on the scrotum was not complete, and so we started using the method of Jenesco, the double spinal tap. We do vary the dose at Bellevue, depending on the age of the patient and the condition. As a rule, our customary dose is about 90 mg. of novocaine. We figure the dose for each particular patient, and in cases of suprapubic cystectomies or epididymectomies, a double spinal injection is done. The spine is tapped in two places, between the 12th dorsal and the first lumbar vertebræ, and between the third and fourth, or the fourth and fifth. The dose figured for that patient is divided equally, and half given above and half below. We have had perfect anæsthesia in every case we have done. Dr. Campbell's complete report on split spinal anæsthesia is not quite ready. We are waiting until we get a good many more cases to prove conclusively the point we make. All of the men who have seen

this work believe there is no question about its efficacy, and its vast superiority over the single dose in selected cases.

Dr. J. Lewis Amster: The use of spinal anæsthesia is of vital importance to the abdominal surgeon and to the urological surgeon. This method has become very popular recently. I think that spinal anæsthesia in the hands of careless, incompetent anæsthetists can do more harm than good in popularizing this method. Babcock is correct when he says that spinal anæsthesia is dangerous if it is given carelessly. If it is unsatisfactory, it is because of some hitch in the technique, and if any unusual symptoms, such as headache, or vomiting, result, then something has been done in the technique which should not be done. I have been interested in the use of regional anæsthesia in major surgery for many years, and it is an exception to the rule for me to give the spinal anæsthesia myself. I usually delegate this work to one who has had a large experience in this particular branch of anæsthesia. I think that unless we are very careful in our technique of spinal anæsthesia, the popularization of this method will sooner or later be destroyed.

Dr. Morris J. Klein: I think the discussion has gone beyond the paper. I mean that men who have discussed it have gotten up and discussed general surgical problems and other problems beyond the discussion of the paper. I think Dr. Campbell ought to be congratulated on what I have seen, and I have seen a great many of the operations at Bellevue, and I must absolutely coincide with the complete report of Dr. Campbell. I think that this discussion may influence some of us who have not had enough experience in this line of spinal anæsthesia, but if we stick to the paper alone, and discuss that, I think it is rather a remarkable forward step, and anybody who uses it as they do at Bellevue should be congratulated because the results are splendid.

Dr. Pugh: It is a great opportunity to listen to the interesting paper of Dr. Campbell. Spinal anæsthesia is a subject in which we have been interested for a long time. Starting with the work of Jenesco some years ago, we became very enthusiastic over spinal anæsthesia. We had a series of 165 cases in which it was used. Everything went beautifully until the last four or five, when we had one death,

one hæmorrhage of the cord, and a paraplegia which persisted for about six months, which stopped the use of spinal anæsthesia in that clinic. A little later we began using it for a number of conditions in general surgery. For urological surgery it is undoubtedly the ideal anæsthetic, and I believe that the "split" method, as proposed by Dr. Campbell, has very great possibilities. There are one or two points, however, on which I cannot agree with him. One is that paravertebral anæsthesia is not painless. I mean to say, in the clinic at Budapest I saw 65 paravertebral anæsthesias given there, and they were absolutely painless, because they were given by a man particularly skilled in that line of work. He is not a surgeon, but a regional anæsthetist. Spinal anæsthesia is undoubtedly excellent for operations on the kidney or ureter. It is probably a little better for the average man than the paravertebral anæsthesia, but for the average suprapubic cystotomy or prostatectomy, I believe it the better idea to use the regional field block which we use very successfully.

Dr. ROBERT GUTIERREZ: I would like to add a few words to Dr. Campbell's interesting paper, which moves us to think and to use spinal anæsthesia more. We do not use very much spinal anæsthesia, and it seems to me that in the clinics abroad they are more enthusiastic than we are here. In the New York Hospital we use regional anæsthesia. Dr. Lowsley has been using it in kidney and ureter surgery and also the epidural method described by Cathelin that we use now as the sacral and parasacral in prostatectomies and bladder operations, and we have indeed been having good results. At Trenton, at the New Jersey State Hospital, we use spinal anæsthesia in a group of cases and in cases of prostate, bladder, and seminal vesicles but unquestionably in European clinics they use the spinal anæsthesia much more extensively.

During my studies in Paris this last year, I saw at the Necker Hospital on the Urological Service, Legueu, who is using the spinal anæsthesia practically in all his cases for bladder, prostate and perineal operations. Also Marion, Pouchet, and Michon, and Faure have been using it in many gynæcological operations satisfactorily. More recently,

Jenesco, who is one of the pioneers in this work, has reported a long series of cases operated upon using the general spinal anæsthesia method without death or accident.

I think it is a question of more efficient and uniform technique as has been pointed out by Labat and Pouchet. I do think that spinal anæsthesia, as well as the local or regional anæsthesia, has its fields and that it should be used in many selected cases, and there is no doubt about any indication as to its future.

I wish to congratulate Dr. Campbell on his interesting paper.

Dr. LABAT: There is no doubt that Dr. Campbell's paper has atracted great attention, and has been of great interest. It is not because we have had so many men taking part in the discussion and because of the lateness of the hour that we shall deprive ourselves of the opportunity of saying a few words. With regard to kidney operations performed under regional anæsthesia, I quite agree with Dr. Pugh that if the anæsthetic is skillfully administered, nephrectomy can be performed painlessly. In the case of spinal anæsthesia, I cannot understand why an injection of 12 centigrams of novocaine made between the 12th dorsal and the 1st lumbar vertebræ should not produce anæsthesia high enough and anæsthetize both the superficial structures and the deeper tissues. It is our experience that an injection thus made produces anæsthesia from the line of the nipples to the toes.

With regard to the double injection, the "split" method, it is a procedure, as Dr. Campbell and Dr. Rubin say, which is attributed to and sponsored by Jenesca. Although it is a procedure which might occasionally be found useful, I do not at all agree with the gentlemen that it is necessary for a bladder operation or a prostatectomy to give two injections. The objection is, first of all, two punctures at different levels. If you apprehend leakage of a spinal fluid through one puncture, you will certainly apprehend it more through two punctures; it is, therefore, a more difficult task to introduce the needle successfully into the spine at two different levels. I do not see how the injections of 12 centigrams, if the correct technique is used, will not produce anæsthesia of the abdomi-

nal wall and of the abdominal and pelvic organs. We give spinal anæsthesia very often. We have had occasion to use it several times a week and we never failed to obtain anæsthesia of the lower part of the trunk and also of the lower extremities.

I would like to insist on position. Dr. Campbell has told us that the Trendelenberg position will improve conditions, such as respiratory disturbances. Why wait until this disturbance occurs to place the patient in that position? Why not place the patient right away in the Trendelenberg position and increase the Trendelenberg for the operation? We need the Trendelenberg for prostatectomies and for all pelvic operations. Why not place the patient in it right away? Babcock was formerly in the habit of keeping his patient's head up, but he is now placing them in the Trendelenberg position immediately after the injection and even more rapidly than I do. He is using a solution of lighter specific gravity while I am using a solution supposedly of greater specific gravity than cerebrospinal fluid. My advice is that the patient be placed in the Trendelenberg position immediately after the injection. It is then, and only then, that there will be no danger of respiratory failure. Low blood pressure seems to be a contraindication to spinal anæsthesia. A patient with a systolic blood pressure of 100 can be given a spinal anæsthesia and he takes it very well. The higher the blood pressure, the greater the fall associated with spinal anæsthesia, and that fall is particularly in the systolic pressure. There can be no dangerous fall in the diastolic pressure for reasons which cannot be discussed at this meeting. The lower the blood pressure, the less is the fall, and, therefore, a patient with a blood pressure of 100 may have a fall to 90 or 85, while a patient with a higher blood pressure may have a drop from 180 to 90. We have, in patients with a blood pressure of 220, observed drops to 110 without bad results. The diastolic pressure does not follow exactly the systolic fall.

I would like to ask Dr. Campbell to tell us what kind of a needle he broke in the spine. The recommendation is always to use a melleable needle whenever the spine is punctured, whether it be in the higher dorsal region or in the

lumbar region, or through the sacral hiatus. It is recommended to use an unbreakable needle and never one of steel.

Spinal anæsthesia is too extensive a procedure to be administered for orchidectomy or epididymectomy. These operations, I am convinced, can be performed by a few injections of novocain, injecting the spermatic cord and superficially around the base of the scrotum. Spinal anæsthesia is too extensive a procedure for such operations, I insist. The principal danger of spinal anæsthesia lies in the carelessness with which it is often accomplished, and in the use of a position which is far from being rational. Attention is not paid to the head being higher or lower than the feet. In certain cases the head of the table is elevated. The disturbance in blood circulation causes the blood to gravitate to the dependent portions of the body, this is, to the feet. The brain is thus left without sufficient blood to keep the respiratory and all the other vital centres at work. Anæmia of the brain is the chief thing which must be avoided in such cases. Finally, I insist that the Trendelenberg position is the rational position during spinal anæsthesia, and that the patient should be placed in that position immediately after the injection has been performed. Moreover, the patient should be kept in the Trendelenberg position at least three hours after operation. The foot of the bed is elevated with shock blocks about eight inches high.

Dr. CAMPBELL: I have enjoyed the discussion immensely. I am not "selling" spinal anæsthesia to anybody; I am merely reporting its use on the Urological Service of Bellevue Hospital.

Regarding the broken needle, I do not know the kind it was. It was a common lumbar puncture needle supplied by Bellevue.

I mentioned the fact that I have never seen an entirely painless nephrectomy performed under regional anæsthesia. They go well until the renal pedicle is clamped and tied, when it has been necessary to give the patient a few whiffs of "psychic anæsthesia."

Regarding regional anæsthesia as an entirely harmless procedure or an anæsthesia without danger, I do not believe that, for in another hospital, not Bellevue, I saw a patient die

on the table shortly after being given a sacral injection by an excellent surgeon. The death did not simulate injection directly into the circulation.

At Bellevue we have been well pleased with the results we have obtained, especially in our particular line of work. We use sacral anæsthesia there quite successfully in certain cases. I personally like sacral anæsthesia very much, and use it in the office a great deal when dealing with a highly sensitive patient. Epididymectomies and orchidectomies have been performed under spinal anæsthesia at Bellevue in tuberculous patients, although we realise they can be done equally well and perhaps with slightly greater safety with local.

BRACHIAL PLEXUS BLOCK.

Details of Technique with Lantern Slide Demonstration.

Gaston Labat, M.D.

Our intention is not to describe the technique of brachial plexus block, but to give you a few details which we consider to be of great clinical value. There are interesting points in the anatomical features of the supraclavicular region that are worth while mentioning. Kulenkampff, who originally devised the brachial plexus block, used to make the injection with the patient seated in a chair. The erect position created favourable conditions for faintness and respiratory disturbances. He subsequently used the recumbent position. The technique consisted in introducing the needle above the mid-point of the clavicle in the direction of the spinous process of the first or second dorsal vertebræ. When the puncture is made in the recumbent position, it is impossible to use Kulenkampff's technique, which is described in Braun's book, and utilize a spinous process as a landmark. We therefore discarded it and took the first rib as the best landmark.

Dr. Livingston has proposed a technique which has given him satisfaction. It is a sub-fascial injection. Instead of reaching the first rib before making the injection, the point of the needle is introduced just beneath the deep fascia. This implies great skill and highly developed tactile sense in finding the deep fascia which in certain cases does not offer great

resistance. In fact, the needle is introduced just beneath the deep fascia because there lies the brachial plexus.

The question of minute anatomy arises here which must be discussed, because it seems to me a great factor in the success of this injection. When the bracial plexus and the subclavian artery are exposed, the picture shows the plexus and the artery passing between two groups of muscles. In front of these passes the omohyoid muscle, then the deep fascia, which invests the trapezius muscle, and the sterno-cleidomastoid muscle, *i.e.*, the deep cervical fascia. Every muscle is covered by an aponeurosis whose resistance to the point of the needle varies considerably; the anterior and posterior groups of muscles between which lie the brachial plexus and the subclavian artery are no exception to the rule. The plexus and the artery are therefore separated from the structures by a fascial investment which represents two walls; the one in front belonging to the scalenus anticus muscle and the other behind to the scalenus medius. These walls proceed laterally and slightly forward to meet the deep cervical fascia. Unless the injection be made between these two walls in the tissues in which the plexus is embedded, there is little hope that the solution will diffuse to the plexus, because fascias are impermeable. A solution injected on one side of a fascia does not under normal conditions reach the other side of that fascia. An example of this impermeability is the injection of a solution within the rectus sheath. The solution thus injected will not pass out of the sheath and it is necessary to make a subcutaneous injection to reach the superficial nerves, the deep injections taking care of only those nerves that lie within the sheath. To deposit the solution between the two aforementioned fascial walls, is, to my mind the greatest factor of success.

Another important point is the site of puncture. Superficial landmarks must be taken with great accuracy in order that the deep landmarks may be reached with some accuracy. In taking the superficial landmarks, we sometimes miss our aim. We must define the extremities of the clavicle in order to find its middle point and while it is very easy to trace the sternoclavicular articulation, the acromioclavicular articulation is not so easy to locate in certain cases. If the site

of entrance of the needle is not very accurate, the injection is made either in front of the plexus or behind it. The fault of beginners is to introduce the needle too far backward in order to avoid the subclavian artery. The puncture of the subclavian artery is not of great significance. I may say it is of no clinical significance. It has been punctured several times for demonstration purposes and these patients have never shown signs of immediate or remote complications. It is even stated that the subclavian artery may be used as a landmark; its puncture preceding the injection of the plexus. Such a practice should, however, be condemned, although the accidental wound of the artery with our fine needle is insignificant.

Dr. Livingston's suggestion of making a subfascial injection without attempting to obtain parasthesias, is, I believe, a very good procedure. The anæsthetic solution thus finds its way to the plexus instead of being carried to it by the point of the needle. This would be the ideal method.. The distribution of the solution along the plexus, according to our personal technique, would perhaps still reduce the percentage of failures, if it were possible to keep the needle always in the subfascial layer.

In thin patients the skin is so close to the first rib that the deep cervical fascia cannot be felt. When the needle has passed through the skin it comes immediately in contact with the rib. In a great percentage of patients of average weight, tactile sense of the deep fascia is obtained after passing the needle through the skin, and the solution can be deposited beneath the deep fascia. On the other side of the first rib is the pleural dome which has been so often punctured in the experimental stage of brachial plexus block. It is therefore recommended to visualize the position of the first rib so that the point of the needle may impinge on the bone instead of passing into the pleural dome. When attempting a subfascial injection, particularly in thin individuals, it is an excellent landmark which serves not only to direct the needle towards the correct site of injection, but to protect the pleura and the lung.